APPLETONS'
POPULAR SCIENCE
MONTHLY.

JULY, 1896.

PRINCIPLES OF TAXATION.

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II.—THE PLACE OF TAXATION IN LITERATURE AND HISTORY.
PART VI.

THE TAX EXPERIENCES OF INDIA.—In contrast with the record of tax experiences in Egypt, that of India under like (British) influences, though equally singular and instructive, is not equally satisfactory. The elements of the problem of raising sufficient revenue to defray the expenses of the state since India passed under British rule and influence are substantially as follows:

A vast area of territory—1,609,151 square miles—with a population comprising more than one fifth of the human race—288,159,692 in 1891—and increasing at the rate of at least 30,000,000 for every decade, a number about equal to the present population of England and Wales; without homogeneity, but divided and subdivided, as is the case in no other country, by diversity of race, religion, caste, and language.* Of the population of India, 217,000,000, according to the census of 1881, were unable to read or write; while as respects property, the testimony of recognized authorities in 1877 was, that the value of the total yield of the land of India from all sources, including the produce of mines and the

* In the Statistical Abstract relating to British India, annually published by the home Government, eighty-eight different languages, distinctively Asiatic or non-European, are recognized as characteristic of the population. In 1884–'85 out of a then total population of 253,891,536, only 202,920 were reported as using English in the sense of a mother-tongue; and only 1,862,626 that admitted of classification as "Christians."

annual value of manufactures, would not average more than forty shillings (ten dollars) per head for the entire population.* As compared with Egypt, the situation in India has this marked difference—namely, that whereas in the former country the extreme poverty of its rural population—the fellahs—has not been due to any lack of fertile land, or any incapacity on their part for obtaining from it a comfortable subsistence with continued betterments in condition, but owing to the fact that they have from time immemorial been deprived of the control of the fruits of their labors; while in India the population is increasing so rapidly—especially under the conditions of peace which have been attendant on British rule—and so disproportionately to the amount of new and fertile soil that can be appropriated, as to leave but little margin, under existing methods of cultivation, for increasing the means of subsistence for the people. In fact, the "Malthusian theory" is completely exemplifying itself in India, which is densely populated, destitute in a great degree of roads and of the knowledge and use of machinery.†

In a debate in the British House of Commons on the Indian budget, in August, 1894, Mr. S. Keay, an ex-official of the Indian Government, stated that in 1892 "he had a census taken of five villages in the presidency of Bombay. The population was 236. These five villages farmed 1,400 acres, the gross crop of which was valued at £193. If a starvation support of 14 shillings a year were allowed to each of the 236 persons and 11 shillings a year for each pair of bullocks kept to till the farm, the net produce of the five villages amounted to £5 for the year. Yet in the same year they paid to the inland revenue £73, and the village books showed that it was done by borrowing from the usurers at 24 per cent."

Mr. Keay further stated that "about seven years ago the Director-General of Statistics for all India published a book in which he stated that 40,000,000 of the people of India habitually went through life on an insufficiency of food. The Government of India wanted to be able to deny the statement, and they sent a con-

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* Resources of Modern Commerce. A. J. Wilson. Longmans, London, 1878, vol. i, p. 57. Taxation in India. Shoshee Chunder Dutt, Justice of the Peace, Calcutta.

† Under the old-time system of native rulers, frequent wars, consequent on foreign invasions and internal race antagonisms, with accompanying famines and epidemic diseases, materially restricted the growth of the population of India. But under the conditions of peace that have been attendant during the last half century of British rule, the population of India has increased so rapidly that the limits of the agricultural capacity of the country, and the consequent means of subsistence for its people, seem to be approaching exhaustion; and one extraordinary drain upon the revenues of the Government in later years has been due to the wise creation of a national famine fund, to be used in cases of periodical emergencies due to failure of the crops, for the relief of multitudes who would otherwise perish by starvation.

fidential circular to the heads of departments and governors, in which they asked whether it was wholly or partially true, not that 40,000,000, but that the greater proportion of the population of India suffered from an insufficiency of food; and they directed that men of 'experience and judgment' should be set to make the inquiries. The replies were contained in five confidential Blue-books. In the district of Rampoor twelve scattered villages were taken, with a total population of 2,000. Of these, 1,600 were cultivators, and the remaining 400 were laborers, artisans, etc. It was found that, after deducting rent and the cost of cultivation, the cultivators had available for their support during the year sixteen rupees each, while the laborers had seventeen shillings a year each as the whole means of their subsistence. In another case it was shown that in a district having a population of over 1,000,000 souls, 173 persons had only thirteen shillings a year each to live upon. In another district the official reports which were contained in Blue-books marked 'confidential' showed that in a large district nearly all the inhabitants had to live upon from three eighths to three quarters of the amount of grain which was ascertained to be the *minimum* that would support a healthy condition of life."

In the debate that ensued, Sir Richard Temple, another ex-official of India, stated that "the calculations referred to by Mr. Keay were not worth the paper they were written on or the breath with which they were uttered. The data upon which they were founded were supposititious, and the deductions drawn from them were impossible. If they were true, the people of India would not be living at all, and the land would be of no market value. Yet, in another breath they were told that large sums of money were being advanced by local banks on security of the land."

Mr. Keay said that the facts and figures were quoted from the Blue-book.

Sir R. Temple retorted that "the facts were no facts at all. The tabular statements were merely tabular statements of particular theories of particular calculators. They were, in fact, delusions and snares. He preferred to take certain general facts which could be tested. He could not know or test how a particular family in India lived. He did, however, know the area of land under cultivation, the population of the country, the ratio of the increase in the population, the expansion of trade, and, above all, the exportation of foodstuffs. Honorable members told them that the people of India were starving, yet India exported food and grain stuffs to such an extent as to threaten disturbance to the markets of Europe, and particularly to disturb the markets of this country [England]. Honorable members told them that the people of India were sinking, yet the population had increased by

30,000,000 in ten years—a greater increase than in almost any other country. No doubt the taxable capacity was low, but he asserted that the people of India were, as to the poorer classes of the population, the lightest-taxed people in the world. The actual value of the produce of one man's land was difficult to test, but the rate of wages was easily ascertained. The poorest laboring man in India could, at the time when he was in India, earn Rs. 5 per month, and he would not pay more than Rs. 2 per annum in taxes.* A man here earning thirty-five pounds a year would not pay less than two pounds in taxation. This meant that in England the poor man paid one seventeenth, while in India the poor man paid only one thirtieth in taxes. Therefore the taxation of India was relatively much lower than in England. How could a people who were exporting such quantities of foodstuffs and who were increasing so greatly in population be said to be dying of starvation? In face of those facts, which could be proved, what weight was to be given by the House to amateur statisticians and their calculations? He had spent twenty-five years among the poorest people in India, and he had also spent fifteen years among the active life of the poorest people of this country. With that experience he asserted that the people of India were not so poor as the people of England." (London Times, August, 1894.)

It was evident, therefore, from the outset that the natural conditions of India were as antagonistic to the adoption of what may be termed the civilized forms of taxation, as they were to the adoption of the Christian religion or English habits and language; and the problem to the new rulers for obtaining revenue for the support of their Government, without resort to the old forms of arbitrary exactions or plunder, has accordingly always been one of great difficulty and delicacy; and the record of their experience in attempting to solve it constitutes an exceedingly novel and important chapter in economic history.

Practically the only guide to them for the determination and collection of taxes has been that of expediency. The imperial revenue of British India for 1893–'94, stated in *tens* of rupees, was £60,193,000, making no allowance for the depreciation of silver. The value of ten rupees is very nearly equivalent to the British pound sterling, or five dollars gold coin of the United States. The ordinary revenue of India for the fiscal year 1893–'94 was, therefore, about $300,968,000. The expenditures exceeded

* The value of the silver rupee—Rs.—in India at the time mentioned by Sir Richard Temple, expressed in terms of the United States gold dollar, was about $0.48 cents. Its present (1896) corresponding gold value is about $0.23.4 cents.

the receipts of revenue to the extent of about $30,000,000, and represented an annual deficit to that extent.*

The sources of revenue in India are mainly seven, but all of them, using the term in its ordinary signification, can not be characterized as "taxation."

The *first* and most important of them is the taxation of land, with which the Asiatic people have been familiar from a most remote period, and the justice of which is least questioned by them. In fact, reliance upon land revenue was a feature of the Indian governments long before England had any control over India. The native rulers maintained themselves for centuries by exacting shares of crops and cash contributions from cultivators of the soil. Taxation of land in India has therefore been retained, and not instituted by the present (British) Government. The entire land of India was nationalized centuries ago, and now as formerly (and as is the case in China) the primary title to all land inheres in the state or Government, and the cultivators of land pay a certain rent in respect to their tenancy.

There are two methods of land assessment in India, which involve a somewhat curious history. A hundred years ago, under the administration of Lord Cornwallis, an arrangement or treaty was made, which then and forever fixed the rate which the tenants of land in the government of Bengal—representing about one fourth of the present area of British India—should pay the state for their occupancy, and which then was regarded as a fair rental; and although since that arrangement was made, the land in question, owing to increased population, new industries, and state expenditures on roads and railroads, has greatly increased in value, and yields to the representatives of the primary lessees threefold or more rental, the British Government has to this day strictly respected its treaty and fulfilled its agreement. The fortunate controllers of the land thus rented—the *zemindars*, or native capitalists—having, however, improved their opportunities to oppress (rackrent) their subtenants, the Indian Government, since 1885, has undertaken to remedy this evil, and with a considerable degree of success. Land throughout India is divided into provinces, and the provinces themselves are divided and subdivided in such way that taxation in each locality is under the direction of an officer familiar with all the matters that must be taken into consideration in taxing justly. A multiplicity of

* "The gross revenue and the gross expenditure of India are very different things from the real revenue and real expenditure. In the gross revenue is included the entire receipts, and in the gross expenditure is included the entire expenditure of the whole railway system of India, the whole of the canal system, and of the irrigation works."—*Speech of Mr. H. Fowler, Secretary of State for India, introducing into Parliament the Budget for India, August 15, 1894.*

rights in the nature of land tenures are recognized in the assessments, and heed is also paid to the character of the lands and the purposes to which they are devoted. No increase of rent is ever allowed upon improvements made by the tenant himself, or upon improvements arising from the expenditure of public money; so that, in the opinion of those who have given personal attention and study to this subject, the English officials have finally established a land revenue system in India on a just basis.

The expense of collecting the land tax is heavy. In the so-called "village assessments" the collection is made by the local authorities. In other cases the large proprietors and notables pay the Government levies and recoup themselves by including their payments in the rents charged to their subtenants—the *ryots*, or peasantry. While the revenues from this source are very reliable, they are not regarded as capable of much further expansion. The gross receipts—imperial, provincial, and local—from the annual rental of tax on land in all India was officially returned for 1893–'94 at 25,589,600 Rx. (or about $123,000,000), representing an average rent or tax of $1.53 per acre. About nine tenths of the entire population of India belong to the agricultural class.

Second in order of importance of the sources of Indian revenue is the tax on salt, which, since its discontinuance in France in 1789, has ceased to be an excise or internal tax in European countries, with the exception of Italy, and which finds its warrant and justification at the present time in India in the fact, that apart from the land tax there is no other method so practical and economic of compelling the masses of its people to directly contribute anything for the support of the Government, inasmuch as the consumption of salt is a necessity for every individual. A very large proportion of the salt required for Indian consumption is imported—chiefly from England—and the total amount on which taxes are collected is about 500,000 tons, or 3,000,000 barrels. The rate of tax is two and a half silver rupees (nominally $1.00) per *maund* of 82·28 pounds. Previous to 1879–'80 the Government maintained, at great expense and popular annoyance, a customs line twenty-five hundred miles in length, to keep salt produced in the states under native rule from entering into British territory without the payment of a heavy duty. This barbarous system, necessitating the constant employment of a large force of native constables, known as *chuprassies*, invested with inquisitorial powers, was abolished at the time above named, by entering into treaties with the native states possessing salt sources, in virtue of which British officials are permitted to supervise their salt works and tax their product before it left them. But this could be only accomplished by paying the states concerned a satisfactory compensation for this con-

cession. The receipts of the imperial (Indian) revenue from the salt tax for 1894 were 8,228,000 Rx. (tens of rupees), or nominally about $41,000,000. The present average annual consumption of tax-paid salt by the people of India has been officially estimated at about ten and three fourths pounds per head, and the average annual burden of the tax on each Indian family of five persons at one rupee and a quarter, or 5*d.* (ten cents); and in considering this tax it is desirable to bear in mind that there is no direct taxation in India either on tobacco or sugar, so that the salt tax is the only direct tax that the Indian peasant need pay, unless he indulges in alcohol or narcotics—the land assessment being regarded as in the nature of rent.

As the price of salt, by reason of the tax, is somewhat higher in India than in most other countries, the question as to its effect upon its population is one of high social and sanitary interest, in respect to which authorities differ. By some* it is contended that the consumption of this prime necessity is thereby greatly restricted, and that much disease, both of men and animals, is thereby engendered; and the trade in salt fish, which might supply a cheap and abundant article of food, is greatly hampered. Others assert that "the poorer classes do not feel aggrieved or complain about it"; that "as a rule the peasantry do not stint themselves on account of it"; and that "no one has ever taken exception to the tax as it stands but the European grievance-monger in the country." But, be this as it may, all are agreed that it would be very difficult to raise a revenue equivalent to that derived from the taxation of salt by any other method.

The *third* largest source of imperial revenue in India is from the Government monopoly of the production and sale of opium; and the annual receipts from which, although at one time in excess of $40,000,000, have of late years greatly diminished, and were officially reported in 1894 as 6,627,571 Rx. ($33,137,855). As the opium product of India is sold mainly to China and the Straits Settlements, and as the export taxes embodied in its price are collected from the people of these countries, they can not, therefore, be regarded as a fiscal burden upon the people of India.

The method of collecting the revenue from opium is substantially as follows: No person in British India may cultivate the poppy, from which the drug is derived, without a license from the Government; and every cultivator is bound to sell the crude product of his crop to the Government at certain factories, where it is manufactured into the opium of commerce. A portion of the manufactured opium is retained for consumption in India, and distributed through venders licensed by the excise depart-

* Wilson's Resources of Modern Commerce. London, Longmans, 1878.

ment. The remainder is sold monthly by auction to merchants, who export it; and on this exportation a duty is levied, from which the imperial revenue from this source mainly accrues. Opium produced in the native states of India pays the export duties when it passes into British territory. The Government prescribes rules for the cultivation of the poppy, and the manufacture, possession, transport, import (from native states) or export, and sale of opium; and any contravention of such rules is subject to stringent penalties. The product of the poppy illegally cultivated and opium made the subject of an offense against the law are liable to confiscation, together with the vessels and packages in which it is found and the animals and conveyances used in transporting it. Notwithstanding all these precautions, the price of opium consumed in the country—about one eleventh part of the whole—is more or less influenced by illicit supplies; so that the Government monopoly of this article is fully effective only in respect to the export trade. But even under such conditions, opium is the most valuable of all the native exports of India; and the annual value of the poppy crop, including the poppy seeds and the poppy oil produced from them (neither of which yield opium), or the annual money return, apart from the Government revenue, that the people of India get out of the crop, is estimated at about $70,000,000.

The *fourth* source in order of importance of the Indian revenue is from the so-called *excise*, which embraces licenses and distillery fees, licenses for the sale of liquors and drugs, and rent of "Toddy" trees—364,624 Rx. ($1,722,120) in 1894; duty on opium consumed in India—732,200 Rx. ($3,661,000) in 1894; fines, confiscations, and miscellaneous; total excise revenue for 1894, 5,388,573 Rx. ($26,942,865). The incidence of this form of taxation falls mainly upon Europeans and "Eurasians" (a modern name given to persons of mixed European and Indian blood). In this connection, the Imperial Secretary for India, in his budget speech (1894), stated that, "whereas in England there was a licensed shop to sell intoxicating liquors to every 106 of the population, in India there was only one for selling liquor and opium to every 2,148 of the population."

Fifth. The stamp system of taxation in India yielded a revenue in 1894 of 4,509,355 Rx., or $22,546,665. Although somewhat heavy in the aggregate, the system is not unpopular, for the reason that it is practically unknown to the mass of the people; the largest items of collection being returned, in 1894, under the heads of "court fee stamps" ($15,317,315) and "commercial and other stamps" ($5,841,995).

Sixth. "Provincial rates." Under this title are included a variety of levies, differing in name, character, and rate in differ-

ent places, and for the furtherance of special objects—as for paying the expenses of hospitals, schools, and police service; for the maintenance and construction of roads and irrigating facilities, the administration of wards' estates, and the like. The revenue reported from this source in 1894 was 3,514,571 Rx. ($17,572,855).

Seventh. Until within a very recent period (1894) the customs system of India—taxes on imports and exports—was one of the simplest in the world. No other country than the United Kingdom imposed duties on so few descriptions of merchandise—mainly on alcoholic liquors, salt, mineral oils, arms, ammunition, and a few special articles of food and drink. Export duties were also levied on rice and some other forms of grain. The aggregate receipts from customs fees, wharf rents, etc., in 1894, were 1,682,373 Rx. ($8,411,865). In March, 1894—the commencement of the Indian fiscal year—the Council of India, acting under the constraint of financial exigencies, imposed duties on almost all kinds of imports, cotton yarns and piece goods—constituting about one third in value of the entire imports by sea—excepted. Subsequently a uniform duty, equivalent to three and a half per cent *ad valorem*, was imposed on all imported cotton goods, and a corresponding excise tax on all the competing products of Indian mills—yarns and other cotton fabrics, the product of Indian hand labor, being exempted. "Except the weaving of fancy and highly elaborated clothing, which is largely conducted in and around Benares and in a few other districts, the handloom manufacture of cotton in India is mainly a spare-time industry, and is not professional."

Other important sources of internal revenue in India are the receipts from the sale of the products of the forests owned or managed by the Government—in the form of timber, firewood and charcoal, bamboos, sandalwood, grass, and other products—the total of which for 1894 was 1,723,022 Rx. ($8,615,110).

An annual tribute or contribution from a large number of native and mainly petty states of India toward the support of the Imperial Government was reported for 1894 at 774,337 Rx. ($3,871,685). On the other hand, the Imperial Government grants annual allowances, or pensions, to the native hereditary rulers of such states or their families, the aggregate of which for the fiscal year 1894 was 508,443 Rx. ($2,542,215).*

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* The British Government has respected the possessions of the native chiefs of India, and about one third of the country still nominally remains in the hands of its hereditary rulers. These, in return for their maintenance and protection by the Imperial Government of India, contribute annually from their resources a comparatively small sum for its support. The independent gross annual revenue of these so-called "feudatory" states is reported to amount to about £6,000,000 ($30,000,000), and their permanent military forces at "something like 300,000."

INCOME TAX.—The experience of the (British) Indian Government in attempting to raise revenue from the taxation of incomes, or by an income tax, is exceedingly interesting, and ought to be most instructive to the people of other countries. As a rule, the annual revenues of the Government of India do not and for a lengthened period have not equaled its annual expenditures, and the increase in the public debt of the country in recent years has accordingly been very considerable.* The major part of this debt, however, has been incurred for the construction of ordinary roads and railways, which in turn have not been unremunerative, and have made possible a large export sale of wheat and other commodities, which before their construction was impossible. The debt, or expenditures resulting in debt, has therefore contributed greatly to the welfare of the people of India. At the same time the demand and necessity for constantly increasing expenditures, continually confronts the Government with the most difficult problem of how to increase its revenue—a problem that very recently has been threatened with increasing embarrassment, owing to the position of not a few people in England, who, with more of sentiment than discretion or knowledge, have opposed the continuance of the present governmental monopoly of the production and sale of opium. A large increase of taxation in any form is regarded as not feasible in India; not so much because of an unwillingness on the part of the people to pay, for they are accustomed to pay all dues which they regard as fairly claimable by the sovereign power, and more especially when the demand is accompanied with control of force; but by reason of the extreme poverty and consequent actual inability of the masses of the people to pay. Experience has, moreover, shown that the natives of India are particularly opposed to all forms of direct taxation, other than on land, and more especially to taxes on houses, vehicles, and trades; and so extreme are their prejudices in this respect that any new levies of such character are only imposed by the Government with the greatest caution.

Something in the way of an income tax, exempting all incomes derived from agriculture, was probably imposed by some of the old-time native rulers of India. But the first attempt on the part of the British Legislative Council of India to revive such a form of direct taxation was made in 1860. What followed is thus forcibly set forth in a speech by Mr. Hope, before the Council, in January, 1886:

"Instead of a native model for direct taxation, softened and adapted to our circumstances, we unfortunately set up that of the

* For the year which closed on March 31, 1896, there was an estimated surplus of about 9,500,000 rupees.

income tax as it was in force in England. To get direct taxation into good working order, even after a suitable model, would have been a work of time and care, in the absence of any record of the names and resources of householders. But what, except failure, could attend a sudden call on relatively ignorant and unlettered millions, at short notice, to assess themselves, or prove right of exemption, to send in elaborate returns and calculations, and to understand and watch their own interests under the system of notices, surcharges, claims, abatements, installments, penalties, and what not, consequent thereon? Necessarily there followed a long train of evils. An army of tax assessors and collectors temporarily engaged could not be pure. They were aided by an army of informers, actuated by direct gain or private animosity. Frauds in assessment and collection went hand in hand with extortion in return for real or supposed exemption. Inquisition into private affairs, fabrication of false accounts where true ones did not exist or were inconvenient, acceptance of false returns, rejection of honest ones, unequal treatment of the similarly circumstanced—all these more or less prevailed. The tax reached numbers not really liable, for *zemindars* illegally recovered it from tenants and masters from servants, while underlings enriched themselves by the threat of a summons.

"Subsequent acts in 1862, while affording relief in some respects, practically stereotyped many inequalities and heartburnings. In later years, the system of assessment by broad classes was an improvement on the earlier complications, but the advance of local officers toward equitable assessment was perpetually being canceled by the alterations in rate and liability, which I next notice.

"Renewed direct taxation in British India thus made a false start, from which it has never recovered. Possibly, with time and care, a great improvement might have been effected, if the law had remained unaltered. But, unluckily, with its too English form came the idea that the tax was to be, as in England, a convenient means of rectifying budget inequalities, and a great reserve in every financial or national emergency. In consequence of this idea, incomes between Rs. 200 and Rs. 500, which had been taxed at two per cent in 1860 were exempted in 1862, the four-per-cent rate was reduced to three per cent in 1863, and the whole tax was dropped in 1865. In 1867 it reappeared in the modified form of a license tax, at the rate of only two per cent at most, but reaching down again to incomes of Rs. 200. In 1868 it became a certificate tax at rates a fifth lower, and again commencing with a Rs. 500 limit. In 1869 it became once more a full-blown income tax at one per cent on all incomes and profits of Rs. 500 and upward. In the middle of the same year it was suddenly nearly

doubled. In 1870 a further rise to fully three and an eighth per cent occurred; but with better times the rate fell in 1871 to one and one-twenty-fourth per cent, with a limit of Rs. 750, and in 1872 the limit was further relaxed to Rs. 1,000 and upward. In 1873 came a second period of total abolition, to be succeeded from 1877 to 1878 by the new series of acts. Along with the changes in rate and incidence just described came changes in name, form, classification, and procedure. With one object or another, twenty-three acts on the subject have been passed since 1860."

An income tax at a low rate, at present existing in India, grants an exemption of 500 rupees on all incomes, and exempts from taxation all income from the ownership of land or the sale of the products of land, and from property solely employed for religious or charitable purposes. It is thus assessable mainly on salaries, pensions, the income of companies, and of the ordinary trades and professions. Its existence is the cause of considerable friction with the officials who administer it, and constant appeals from their decisions are made from all parts of the country. In fact, this tax, at its present low rate, is universally detested, and the receipts from it are comparatively so inconsiderable—only 1,717,627 Rx. ($8,588,135) in 1894—that it may be regarded as a fiscal failure. Its whole experience in India furthermore reaffirms what is worthy of being regarded as an economic principle, namely, that when an income tax ceases to be regarded as generally oppressive it ceases also to be remunerative to the state.

One other point in this connection is especially worthy of notice. For a long period of years India has been characterized as a "sink-hole" of the precious metals, or, in other words, there has been for many years a continuous flow of the precious metals —gold and silver—into India, where they have to a large extent disappeared, undoubtedly by burial under ground for the purpose of hoarding and concealment. The motive for this under the Mogul and native rulers was unquestionably to escape direct plunder or confiscation; but under British rule these hoards, amounting unquestionably to many hundreds of millions, are not taxed, mainly by reason of their inaccessibility, and partly by the recognized policy of the Government to avoid direct taxation of active capital, and encourage, by making safe its employment, the tendency of these buried treasures to come to light and enter into the channels of trade. And that this policy has been a wise one is shown by the fact that within recent years there has been an increasing disposition on the part of the Indian owners of concealed treasures—especially the Indian princes or rajahs—to withdraw them from their hoarding places and invest them in Government bonds, or other desirable, interest-bearing securities; and in this way a very great addition to the world's active stock,

the money metals, may be anticipated in the perhaps not-distant future.

In the year 1893 the burden of taxation on the people of India, inclusive of the revenue derived from the rent of land, was officially estimated at two rupees and four annas, or nominally less than fifty cents per head; or, exclusive of the revenue from land, at about twenty-three cents per head—a rate relatively much lower than the taxation of England; so that, if the taxable ability of the people of India is low, the poorer classes of that country, it is claimed, are more lightly taxed than the poorer classes of Europe, or even of the United States. Before England assumed dominion in India the system of exaction of her native rulers was so perfected that they were assured of the very last penny that could be taken from the ryots, or peasantry, without stripping them of everything; leaving to the tenant class little more than the privilege of living. To-day the existing system of taxation in India is conceded to be at least eminently just. To-day it is generally admitted that there is no government in the world whose administration is more honestly conducted, and which is now doing more for the material good of the governed, than the present British Government of India. And herein is to be found the secret of England's success in ruling the vast congeries of people of different races, languages, and religions, known to us as India.

The consideration of another matter of recent occurrence and of the highest economic and social interest and importance, appropriately finds place in any discussion of the tax system of British India; more especially because it sets forth an attempt, founded on an unwarranted sentiment, indirectly to impose a large additional burden of taxation on the people of that country. As already pointed out, a present annual receipt of some $33,000,000 of revenue from the monopoly of the production and sale of opium, the incidence of which does not fall upon the Indian people, constitutes an important factor in this system. Acting on the assumption that the continued use of this drug, as a narcotic and stimulant, is in the highest degree injurious to the consumer—worse even than the continued use of alcohol—and especially demoralizing and destructive to the people of China, who are the purchasers and consumers of the major part of the opium product of India, a body of public opinion has in recent years grown up in Great Britain whose representatives hold that it was disgraceful and positively wicked for a people professing to be moral and enlightened to engage in or sanction the business of producing and supplying opium; and that it is the duty of their Government to at once interfere and put an end to it. And in recognition of this public opinion, and in deference to a numerously signed address to the Crown, the British Government, in

September, 1893, created a commission, consisting of nine eminently qualified persons, including two natives of India of high position and unconnected with the Government, and an eminent physician, to inquire into and fully report on this whole subject. The first report of the commission, published in 1894 and presenting simply the evidence taken in England, was an exhibit of the most interesting but utterly antagonistic and contradictory opinions and evidence. For the petitioners, sixteen witnesses, mainly missionaries, medical men connected with missions and residents for considerable periods in India and China, were called; and nearly all of these, as the result of personal experience and observation, testified in the most positive manner, and in consonance with popular opinion, that the use of opium physically, morally, and socially is highly deleterious, and ought to be discouraged, and if possible absolutely prevented. Considered by itself this testimony would seem to be conclusive and incapable of refutation. But, on the other hand, an equal number of witnesses—English officials, qualified by education, lengthened residence in India and China, and exceptional opportunities for observation, civil servants, medical men of the highest reputation connected with hospital and sanitary work and with the army in every part of India—gave unqualifiedly contradictory evidence, which may be summed up as follows: That opium has been used for centuries in India and China, without any extensive deleterious influence on the population; that the "Sikhs" of India, who in point of physical structure and health are claimed to be the finest people in the world, and whose religion forbids the use of tobacco, are habitual users of it; that while the excessive use of opium is unquestionably in a high degree deleterious, it is far less so than the excessive use of alcohol; that the use of opium in India and China is comparatively much less than the use of ardent spirits in Great Britain; that the excessive use of it, as by the so-called "opium sot," is the result very largely of the circumstance that the miserably poor afflicted with disease in India, China, and other Asiatic countries where there is no intelligent medical treatment, and little or no hospital service, resort to it as the only means of lessening their sufferings; that so far from the allegation being true that the supply of opium by India to China is disastrous in the highest degree to the people of the latter country, the fact is that the use of the Indian product, owing to its higher quality and price, is almost wholly restricted to the wealthier classes of China; that the cultivation of the poppy for the production of opium is very general in China, and to such an extent that one single province of the empire annually produces more opium than the entire export of India; and, finally, that any attempt on the part of either the Indian or Chinese Government

to interfere with the production and sale of opium, with a view of restricting or preventing its consumption, would be utterly futile, and in the case of the former country would undoubtedly lead to revolution.

One witness, Surgeon-General Sir William Moore, stated as the result of thirty-three years' service and observation in India, that opium-smoking is practically harmless, and opium water not only harmless, but beneficial in moderation, and a prophylactic against malarial fever.

The following circumstance was also regarded as substantiating this position: During the years 1893–'94 the island of Hong-Kong, on the Chinese coast, was ravaged by a pestilence, in the nature of a filth disease, of great malignity. Since its abatement it is claimed, with an accompanying array of evidence, that the opium smokers and eaters were almost without exception exempted from the pest.

Very naturally, also, the (British) Indian civil-service officials, holding the view that the large revenue derived by the Government from the monopoly of the production and sale of opium is in no sense a tax burden upon the Indian people; and recognizing also the great difficulty (but absolute necessity) of making good the deficiency consequent upon the abrogation of such revenue through new and additional taxation upon the people, were unanimously of the opinion that any change in the existing system in respect to opium would be in the highest degree inexpedient and unwarranted. When the question was put to Sir John Strachey, who in the course of thirty-eight years of Indian civil service has filled almost every post, from the most subordinate to the governorship of provinces and membership of the Government of India, how he accounted for the great contrariety of belief in respect to the opium question, he made answer as follows:

"The ignorance that prevails in this country [England] regarding everything Indian is enormous, and is not confined to those whom we expect to be ignorant, but extends to the most highly educated classes. It extends to all Indian subjects—history, geography, the conditions and habits of the people, the constitution of the Government—in fact, everything. I will give an illustration which always seems to me to have a useful bearing on this opium question. Mr. Buckle, in his History of Civilization, derives all the distinctive institutions of India and the peculiarities of its people from the fact, that the exclusive food of the natives of India is rice. It follows from this, he tells us, that caste prevails, that oppression is rife, that rents are high, and that customs and laws are stereotyped. I have no doubt that if Mr. Buckle had been asked, he would have said that the same cause accounted for the consumption of opium in India. I sometimes ask my English

friends, when they talk about opium, what they suppose to be the ordinary food of the people of India. The almost universal answer, perhaps with an air of displeasure that they should be asked such a foolish question, is that of course it is rice. I believe that nine tenths of the educated men and women of this country believe this to be true. When they have not learned such an elementary fact as this, that throughout the greater part of India rice is no more the ordinary food of the people than it is in England, how can we be surprised if they do not know the truth about opium? We who have spent our lives in India are not all fools or impostors. When I hear the Government of India charged with the abominable wickedness of poisoning its own subjects, and millions of Chinese also, for the sake of filthy lucre, there is only one reason that prevents me from being filled with indignation, and that is that I know that these charges are the offspring of ignorance alone. Unfortunately, this does not make them less serious, for, of all enemies to human progress, ignorance is the most formidable, and is especially formidable when, as in this present case, it is combined with honest enthusiasm and an anxious desire for what is right."

The commission, having finished its investigations in England, visited India, and there renewed them in nearly every place of importance for obtaining information. It examined seven hundred and twenty-three witnesses, of whom four hundred and sixty-six were natives of India or China, including government officials, planters, landowners, traders, members of the professional classes, especially physicians, missionaries of nearly every denomination, military officers and private soldiers, and the chiefs and officials of the native states.

As a result of this elaborate inquiry, the commission, by a majority of eight to one, pronounced clearly and unhesitatingly in favor of the maintenance of the existing system of opium production and sale of opium in India; finding no evidence of extensive moral or physical demoralization arising in India from the use of the drug, or of any desire on the part of its people or of the Chinese Government to prohibit it.

The commission also decided, in respect to the effect on the finances of India of a prohibition of the sale and export of opium, that, "taking into consideration the compensation payable, cost of the necessary preventive measures, and the loss of revenue that would result from a policy of prohibition, the finances of India are not in a condition to bear the losses that such a policy would entail."

The testimony of the missionaries in India before the commission was not unanimous. That of the members of the American Methodist Episcopal and Canadian Presbyterian commissions,

and the representatives of the Presbyterian and Baptist missions, was in favor of prohibition. On the other hand, the views of the Episcopal bishops and clergy of Calcutta and Lucknow, and of the Roman Catholic Archbishop of Calcutta, were adverse to prohibition. Several of the former, however, frankly admitted that the evils of the opium habit, deplorable as they undoubtedly are, have been grossly exaggerated, and the good that it accomplishes has been but little recognized.

The use of opium in India and China is as much a natural habit as the use of alcohol among Western nations. It has been practiced in those countries for centuries, and it would seem impossible by legislation, and especially by the legislation of an alien nation, to do anything more than control the more manifest evils resulting from it. A policy of rigid restriction of the use of opium would unquestionably be a substitution of the use of opium by alcohol; and all the evidence given before the commission as to the evils arising from the opium habit showed, that as a source of social disorder, organic disease, insanity, and suicide, opium is not to be compared with alcohol.

NOTE.—For the full details of this most interesting inquiry, whether regarded from an economic, social, or medical point of view, reference is made to the First Report of the Royal Commission on Opium, with minutes of evidence and appendices, presented to Parliament in 1894, and to two final reports, Parts I and II, with historical appendices, etc., presented to Parliament in 1895, after the return of the commission from its visit to India.

PHOTOGRAPHING ELECTRICAL DISCHARGES.

BY WALTER E. WOODBURY,
EDITOR OF THE PHOTOGRAPHIC TIMES.

PHOTOGRAPHY plays many important parts in modern science. It assists the astronomer by revealing the existence of thousands and thousands of worlds veiled in the obscurity of immeasurable distance and invisible to the eye even when aided by the most powerful telescope in existence. The chemist has recognized the value of it in registering the belted zones of the spectrum. It aids the meteorologist by placing in his hands permanent records of the dark nimbus and the bright rolling cumulus clouds, the lightning flash, and the automatic registration of the rise and fall of the barometer and thermometer. The microscopist is able to photograph the disease-bearing generations of bacteria, vibrio, and schizomycetes, and to magnify their images a thousandfold for the benefit of the student. It determines the depth of the sea, the direction of currents, and the velocity of projectiles. It detects the spurious bank note or signature, the vibration of suspected bridges, and no traveler's equipment is

complete nowadays unless it contains a complete set of photographic apparatus.

These are but a few among the many things that photography does for us. Each year reveals some fresh uses to which it can be placed.

Quite recently the electrician has discovered its value to him in many ways, principally in registering electrical discharges, so that the same may be carefully studied at leisure. At a meeting of the British Association in 1892, Mr. A. A. Campbell Swinton showed some most interesting photographs of electrical discharges which are here reproduced (Figs. 1 and 2). According to an account of them given in the Electrical Review, these figures were

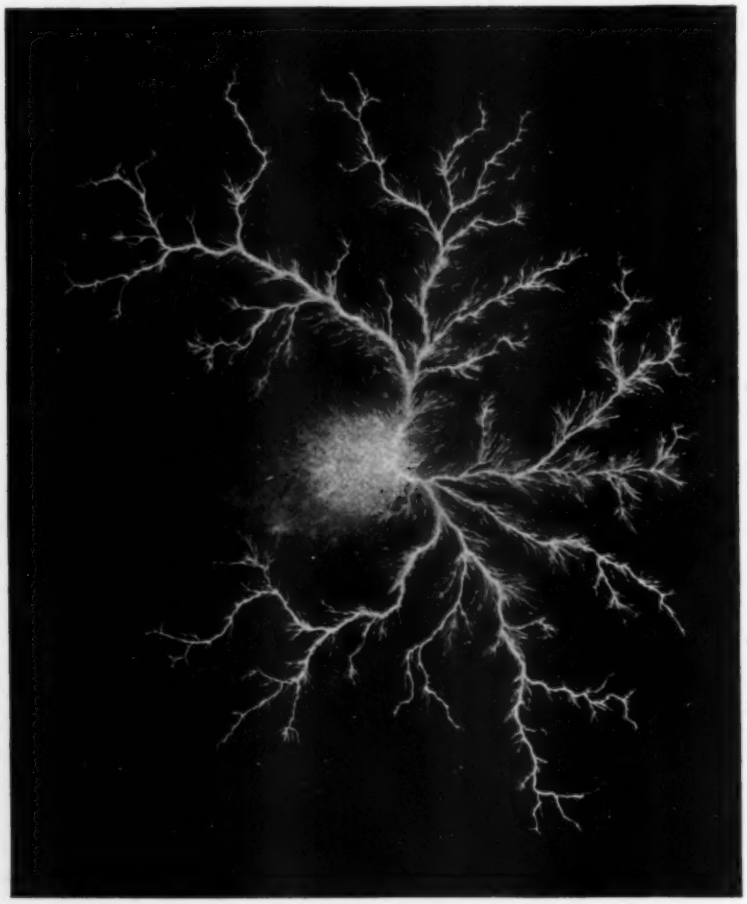


FIG. 1.—A POSITIVE DISCHARGE.

all obtained without the employment of a camera or lens, but produced by merely causing the electrical discharges to take place across the sensitive surface of an ordinary photographic dry

plate. Such a plate consists of a sheet of glass coated over with bromide of silver incorporated in a film of gelatin. When single positive or negative discharges are desired, the photographic plate,

FIG. 2.—A NEGATIVE DISCHARGE.

the back of which is covered with tin foil, is placed between the two discharging points, and the strength of the discharge is regulated so that, while it shall cover as much of the plate as possible, it shall not spread over the edge. The tin foil performs a double function: it does away with the spark on the back of the plate, which would otherwise occasion a confused figure; and it also assists in causing a uniform spreading out of the discharge. It does not seem to modify the character of the figure produced in any way. It, however, affects its form, since, if the foil be smaller than the plate, the discharge seems to have a great disinclination to extend itself beyond the edge of the foil, but would even curve

round to avoid doing this. The arrangement adopted, when it is desired to obtain both positive and negative discharges simultaneously on the same plate, and when connecting sparks from positive to negative are desired, is similar, only in these cases the two discharging points are placed on the film side of the plate.

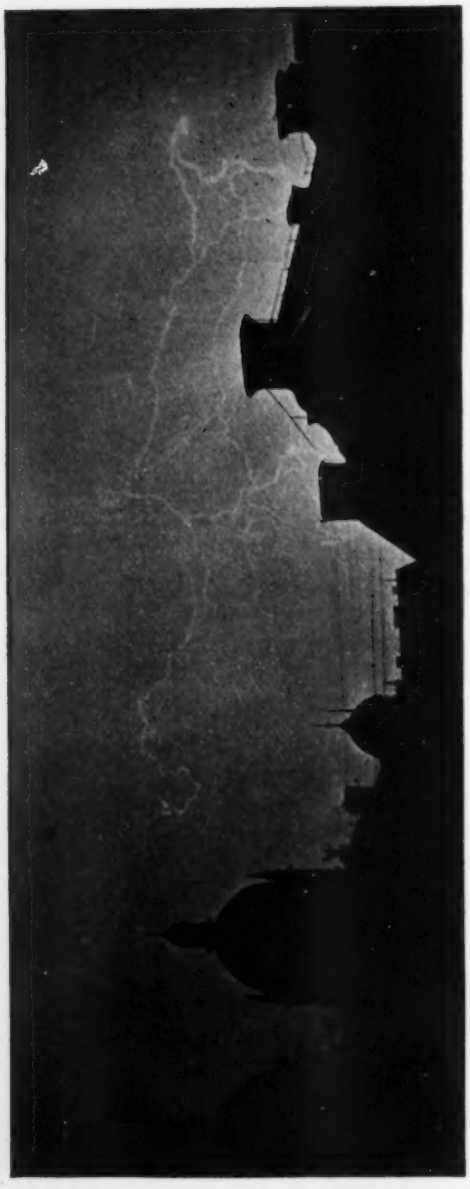


FIG. 8.—SEXTUPLE LIGHTNING FLASH. (By Prof. Zenger.)

Many very beautiful photographs of lightning flashes have been made. They are not at all difficult to get. It is only necessary to wait for a suitable stormy night, point the camera containing the sensitive plate in the direction of the storm, remove the cap, and await the flash. The photographer of lightning flashes is sometimes startled to obtain in his finished picture streaks of lightning, some white and others *black*, the latter being produced by the flashes which were so actinic as to produce upon the sensitive film the phenomenon known as "reversal."

One of the most interesting photographs of lightning flashes that I have seen is that reproduced above. It has been kindly sent to me by Prof. Ch. von Zenger, the renowned meteorologist. It was made on May 20, 1894, when a terrific storm, of short duration fortunately, broke over the town of Prague. The lightning depicted in the photograph struck four houses at once, doing considerable damage. It will be noticed that descending from the clouds are six discharges; one flash can

be distinctly traced on its journey to the lightning conductor of the cupola of the Academy of Sciences.

The most interesting part of this photograph is the shadow of the cupola on the wet and foggy heavens. The intensity of the

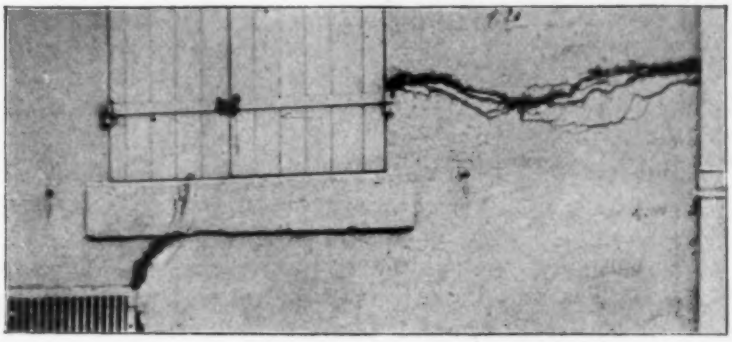


FIG. 4.—TRACES OF A LIGHTNING STROKE.

light produced by the lightning is the cause of this peculiar effect, which I believe has never been obtained before or since. It is analogous with the phenomenon commonly known as the Specter of Brocken.

At a meeting of the Academy of Sciences, held a short time ago, Prof. Zenger read a most interesting paper upon the subject of Electricity as a Vortex Motion, in which he endeavors to prove that electrical discharges, no matter what their origin, produce a vortex motion on matter lying in the electric field. He makes the following experiment: A spark from a Ruhmkorff coil or a Wimshurst machine is discharged within the receiver of an air pump, under which has been placed a test tube containing diluted ammonia and another containing hydrochloric acid. At the instant of the discharge there will be visible eddies or little whirlwinds, rendered visible by the tiny crystals of ammonium chlorid suspended in the air. In circling about they are condensed into peculiar shaped veins which fall upon the plate of the air pump, arranging themselves in somewhat the same manner, says Zenger, as did the *débris* from the roofs and trees during the cyclone in the valley of Roux in Switzerland—i. e., they form lines of electric force.

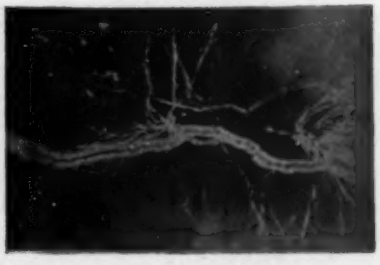


FIG. 5.—DISCHARGE OF A WIMSHURST MACHINE.

Prof. Zenger sends me some very interesting photographs in

support of the vortex theory. Fig. 4 shows the marks left by a stroke of lightning on the wall of a house at Mort, illustrating its course from the iron water pipe to the iron hinges of the window, and from thence to the iron sewer grating. For comparison he sends two other photographs (Figs. 5 and 6). These are obtained by the discharge of an immense Ruhmkorff induction coil containing one hundred thousand metres of insulated copper wire. Two small triangles of tin foil are glued opposite to one another on a photographic plate, and when dry the whole is

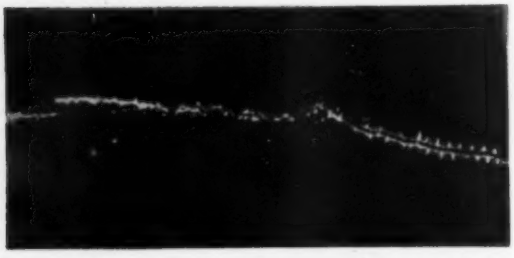


FIG. 6.—DISCHARGE OF A RUHMKORFF INDUCTION COIL.

FIG. 7.—ARTIFICIAL SOLAR ECLIPSE.

covered with a light brownish coating of lampblack. After the discharge a white track is found, as shown in the photographs. Both these pictures show evidence of the vortex motion of the

lampblack driven off by the discharge, and the same peculiar formation is seen in the lightning flash as in Fig. 4. Between the dark filament of intact lampblack and the borders of the electric tracings there is a multitude of fine helicoidal curves filling the white traces left on the smoked glass. These helicoidal spires proceed to the right and left, and on about the middle of the trace the destruction of the two opposing motions produces the phenomena of discharge, viz., light, heat, sound, and mechanical effects. Zenger claims that these, his experiments, serve to show that the undulatory theory of Herz is very defective, there being no motion in plane waves, nor, as in the case of polarized light, is there any in circular or elliptical waves on a cylindrical surface.

"I could show," writes Prof. Zenger, in a recent letter to the writer, "that the solar phenomena, such as the solar corona and

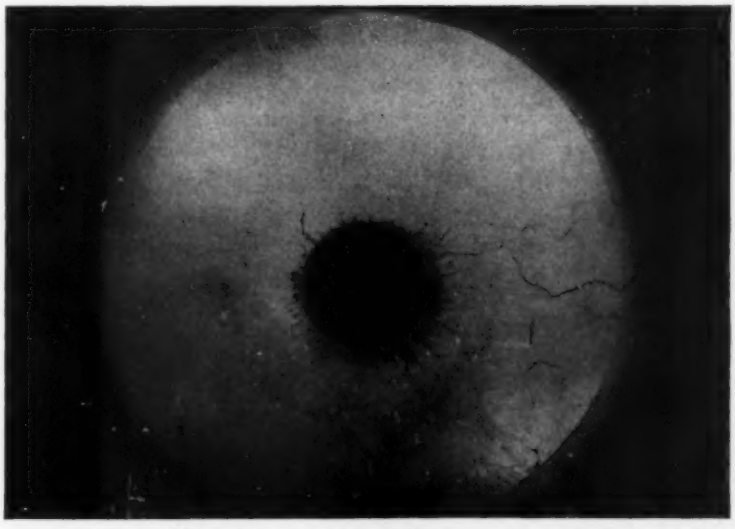


FIG. 8.—IMITATION OF THE SOLAR CHROMOSPHERE AND CORONA.

protuberances, are also due to electric discharges continually given off from the sun's surface. Fig. 7 shows the effect of positive discharges from a circular disk of tin foil into the smoked surface of a glass plate. It will be noticed that we have facsimiles of all the forms of solar protuberances. In Fig. 8 we see the effect of a positive discharge from a hollow hemisphere into the smoked surface of a glass plate, on the middle of which was fixed a lump of wax. The effects are analogous to the chromosphere and to the inner and outer layers of the solar corona produced by the superposition of the lines of electric force radiating from different parts of the spherical surface."

Prof. Zenger's photographs are remarkably interesting and

are valuable assistants in support of the vortex theory which he advances. I hope at an early date to supplement this article with some still more interesting examples of the photography of electrical discharges.

THE GENIUS AND HIS ENVIRONMENT.

By J. MARK BALDWIN,
PROFESSOR OF PSYCHOLOGY IN PRINCETON UNIVERSITY.

PSYCHOLOGICAL science has reached a sort of understanding in these recent years of the individual and of the social setting in which he customarily disports himself; and the duty now devolves upon it of dealing with the exceptions to the rule. No one will be disposed to deny certainly that the genius is in some way exceptional; and if any instance can, by showing what society is not, cast light on what it is, the genius is the man to question. So it is my purpose in this paper to endeavor to understand him, as far as may be, without putting ourselves in his shoes; for apart from the inherent difficulty of assuming his exceptional rôle, it may for another reason be more comfortable not to do so, for under the exceptions to our social rule we are forced to include also these other extremes found in the weak-minded and the insane.

The facts about the genius seem to indicate that he is a being *sui generis*. Common mortals stand about him with expressions of awe. The literature of him is embodied in the alcoves of our libraries most accessible to the public, and even the wayfaring man, to whom life is a weary round, and his conquests over Nature and his fellows only the division of honors on a field that usually witnesses drawn battles or bloody defeats, loves to stimulate his courage by hearing of the lives of those who put Nature and society so utterly to rout. He hears of men who swayed the destinies of Europe, who taught Society by outraging her conventions, whose morality even was reached by scorn of the peccadilloes which condemn the ordinary man, to whom might makes right, and *homo mensura omnium*. Every man has in him to some degree the hero-worshiper, and gets inflamed somewhat by reading Carlyle's Frederick the Great.

Of course, this popular sense can not be wholly wrong. The genius does accomplish the world movements. Napoleon did set the destiny of Europe, and Frederick did reveal, in a sense, a new phase of moral conduct. And the truth of these things is just what makes the enthusiasm of the common man so healthy and stimulating. It is not the least that the genius accomplishes that

he thus elevates the traditions of man, inspires the literature that the people read. He sows the seeds of effort in the fertile soil of the newborn of his own kind, while he leads those who do not have the same gifts to rear and tend the growing plant in their own social gardens. This is true: and a philosophy of society should not overlook either of the facts—the actual deeds and the peculiar influence of the great man upon their own time—or his lasting place in the more inspiring social tradition which is embodied in literature and art.

But it is not my aim to add to the literature of hero-worship. The considerations on that side are so patent that he who runs may read. My aim is to present just the opposite aspect of these apparent exceptions to the canons of our ordinary social life, and so to oppose the extreme claim made by the writers who attempt, in the name of social philosophy and science, to blur the lines of sane thought on these topics. For it only needs a moment's consideration to see that if the genius has no reasonable place in the movement of social progress in the world, then there can be no possible doctrine or philosophy of such progress. To the hero-worshiper his hero comes in simply to "knock out," so to speak, all the regular movement of the society which is so fortunate, or so unfortunate, as to have given him birth: and by his initiative the aspirations, beliefs, struggles of the community or state get a push in a new direction—a tangent to the former movement or a reversal of it. If this be true, and it be further true that no genius who is likely to appear can be discounted by any human device before his abrupt appearance upon the stage of history, then the history of facts takes the place of the science or philosophy of them, and the chronicler is the only historian with a right to be.

Our genius, then, is a very critical factor in human thought. Not only is he the man from whom we expect the thought; he is also the man who, if the hero-worshiper is right, traduces thought. For of what value can we hold the contribution which he makes to thought if this contribution runs so across the acquisitions of the earlier time, and the contributions of earlier genius, that no line of common truth can be discovered between him and them? Then each society would have its own explanation of itself, and that only so long as it produced no new genius. It may be, of course, that society is so constituted—or, rather, so lacking in constitution—that simple variations in brain physiology are the sufficient reason for its cataclysms; but a great many efforts will be made by the geniuses themselves to prove the contrary before this highest of all spheres of human activity is declared to have no meaning—no thread which runs from age to age and links mankind, the

genius and the man who plods, in a common and significant development.

It is, therefore, on the side of just this endeavor that I write. It seems that we have now at hand in our recent literature some social truths of such generality that certain things may be said of social progress which do not rob the genius of his credit, nor of his influence, even though they do tend to explain him. They go further, indeed, in that they explain him in the same terms and to the same extent that they explain the common man and society too. We may turn to these considerations.

I.

The first and most general position which has come as a new insight, in the confusion of present-day discussion, is indicated by a phrase which I have used elsewhere—"Social Heredity." The theory of social heredity has been worked up through the contributions, from different points of view, of several authors. I shall first expound this point of view in my own way, bringing out most prominently the aspects of social heredity which seem to be of value for the true "appreciation" of the genius. What, then, is social heredity?

This is a very easy question to answer, since the group of facts which the phrase describes are extremely familiar—so much so that the reader may despair, from such a commonplace beginning, of getting any novelty from it. The social heritage is, of course, all that a man or woman gets from the accumulated wisdom of society. All that the ages have handed down—the literature, the art, the habits of social conformity, the experience of social ills, the treatment of crime, the relief of distress, the education of the young, the provision for the old—all, in fact, however described, that we men owe to the ancestors whom we reverence, and to the parents whose presence with us perhaps we cherish still. Their struggles, the Fourth of July orator has told us, have bought our freedom; we enter into the heritage of their thought and wisdom and heroism. All true; we do. We all breathe a social atmosphere; and our growth is by this breathing-in of the tradition and example of the past.

Now, if this be the social heritage, we may go on to ask, Who are to inherit it? And to this we may again add the further question, How does the one who is born to such a heritage as this come into his inheritance? And with this yet again, How may he use his inheritance—to what end and under what limitations? These questions come so readily into the mind that we naturally wish the discussion to cover them, even apart from the requirement which is urged upon us, in these latter days, that we make all social discussion as biological as possible. The term heredity

does certainly bring up a biological line of thought, and the analogy from evolution doctrine is materially helpful; so we need not be afraid of it.

Generally, then, who is eligible for the social inheritance? This heir to society we are, all of us. Society does not make a will, it is true; nor does society die intestate. To say that it is we who inherit the riches of the social past of the race, is to say that we are the children of the past in a sense which comes upon us with all the force that bears in upon the natural heir when he finds his name in will or law. But there are exceptions. And before we seek the marks of the legitimacy of our claim to be the heirs of the hundred years of accumulated thought and action, let us say, of this American continent, it may be well to advise ourselves as to the poor creatures who do not enter into the inheritance with us. They are those who people our asylums, our reformatories, our jails and penitentiaries; those who prey upon the body of our social life by demands for charitable support, or for the more radical treatment by isolation in institutions: indeed, some who are born to fail in this inheritance are with us no more, even though they were of our generation; they have paid the penalty which their effort to wrest the inheritance from us has cost, and the grave of the murderer, the burglar, the suicide, the red-handed rebel against the law of social inheritance, is now their resting place. Society then is, when taken in the widest sense, made up of two classes of people—the heirs by right and the rebels by birth.

We may get a clear idea of the way a man attains his social heritage by dropping figure for the present and speaking in the terms of plain natural science. Ever since Darwin propounded the law of "natural selection" the word "variation" has been current. The student in natural science has come to look for variations as the necessary preliminary to any new step of progress and adaptation in the sphere of organic life. Nature, we now know, is fruitful to an extraordinary degree. She produces many specimens of everything. It is a general fact of reproduction that the offspring of plant or animal is quite out of proportion in numbers to the parents that produce them, and also to the means of living which await them. One flower produces seeds which are carried far and near—to the ocean and to the desert rocks, no less than to the soil in which they may take root and grow. Insects multiply at a rate which is simply inconceivable to our limited capacity for thinking in figures. Animals also produce more abundantly, and man has children in numbers which allow him to bury half his offspring yearly and yet increase the adult population from year to year. This means, of course, that whatever the inheritance is, all can not inherit it—

some must go without a portion in natural goods if the resources of Nature are in any degree limited. That the resources of Nature are inadequate to provide for such numbers, with the extraordinary increase, is a matter of course; for if not so now, how soon must it become so, as the increase goes on? Nature solves the problem in the simplest of ways: all the young born in the same family are not exactly alike; "variations" occur. There are those that are better nourished, those that have larger muscles, those that breathe deeper and run faster. So the question who of these shall inherit the earth, the fields, the air, the water —this is left to itself. The best of all the variations will live, and the others will die. Those that do, have thus, to all intents and purposes, been "selected" for the inheritance, just as really as if the parents of the species had left a will and had been able to enforce it. This is the principle of "natural selection."

Now, this way of looking at problems which involve aggregates of individuals and their distribution is becoming a habit of the age. Wherever the application of the principles of probability do not explain a statistical result—that is, wherever there seem to be influences which favor particular individuals at the expense of others—men turn at once to the principle of variations for the justification of this seeming partiality of Nature. And what it means is that Nature is partial to individuals *in making them*, in their natural heredity, rather than after they are born.

The principle of heredity with variations is a safe assumption to make in regard to mankind; and we see at once that in order to come in for a part in the social heritage of our fathers we must be born fit for it. We must be born so endowed for the race of social life that we assimilate, from our birth up, the spirit of the society into which we are reared. The unfittest, socially, are cut off. In this there is a distinction between this sphere of selection and that of the organic world. There the fittest survive, the others are lost; here the unfittest are lost, all the others survive. Social selection weeds out the unfit, the murderer, the most unsocial, and says to him, "You must die"; natural selection seeks out the most fit and says, "You alone are to live." The difference is important, for it marks a prime series of distinctions, when the conceptions drawn from biology are applied to social phenomena; but for the understanding of variations we need not now pursue it further.

Given social variations, therefore, differences among men, what becomes of this man or that? We see at once that if society is to live there must be limits set somewhere to the degree of variation which a given man may show from the standards of society. And we may find out something of these limits by looking at the evident, most marked differences which actually ap-

pear about us. First, there is the idiot. He is not available, from a social point of view, because he varies too much on the side of defect. He shows from infancy that he is unable to enter into the social heritage because he is unable to learn to do social things. His intelligence does not grow with his body. Society pities him if he be without natural protection, and puts him away in an institution. So of the insane, the pronounced lunatic; he varies too much to sustain in any way the wide system of social relationships which society requires of each individual. Either he is unable to take care of himself, or he attempts the life of some one else, or he is the harmless, unsocial thing who wanders among us like an animal or stands in his place like a plant. He is not a factor in social life; he has not come into the inheritance.

Then there is the extraordinary class of people whom we may describe by a stronger term than those already employed. We find not only the unsocial, the negatively unfit, those whom society selects with pity in its heart; but there are also the antisocial, the class whom we usually designate as criminals. These persons, like the others, are variations; but they seem to be variations in quite another way. They do not represent lack on the intellectual side always or alone, but on the moral side, on the social side, as such—for morality is in its origin and practical bearings a social thing. The least we can say of the criminals is that they tend, by heredity or by evil example, to violate the rules which society has seen fit to lay down for the general security of men taken together in the enjoyment of the social heritage. So far, then, they are factors of disintegration, of destruction; enemies of the social progress which proceeds from generation to generation by just this process of social inheritance. So society says to the criminal also, "You must perish." We kill off the worst, imprison the bad for life, attempt to reform the rest. They too, then, are excluded from the heritage of the past.

So our lines of eligibility get more and more narrowly drawn. The instances of exclusion now cited serve to give us some insight into the real qualities of the man who lives a social part, and the way he comes to live it.

II.

Passing on to take up the second of the informal topics suggested, we have to find the best description that we can of the social man—the one who is fitted for the social life. This question concerns the process by which any one of us comes into the wealth of relationships which the social life represents. For to say that a man does this is in itself to say that he is the man so-

ciety is looking for. Indeed, this is the only way to describe the man—to actually find him. Society is essentially a growing, shifting thing. It changes from age to age, from country to country. The Greeks had their social conditions, and the Romans theirs. Even the criminal lines are drawn differently, somewhat, here and there; and in a low stage of civilization a man may pass for normal who, in our time, would be described as weak in mind. This makes it necessary that the standards of judgment of a given society should be determined by an actual examination of the society, and forbids us to say that the limits of variation which society in general will tolerate must be this or that.

We may say, then, that the man who is fit for social life *must be born to learn*. The need of learning is his essential need. It comes upon him from his birth. Speech is the first great social function which he must learn, and with it all the varieties of verbal accomplishment—reading and writing. This brings to the front the great method of all his learning—imitation. In order to be social he must be imitative, imitative, imitative. He must realize for himself by action the forms, conventions, requirements, co-operations of his social group. All is learning; and learning not by himself and at random, but under the leading of the social conditions which surround him. Plasticity is his safety and the means of his progress. So he grows into the social organization, takes his place as a *socius* in the work of the world, and lays deep the sense of values, upon the basis of which his own contributions—if he be destined to make contributions—to the wealth of the world are to be wrought out. This great fact that he is open to the play of the personal influences which are about him we call, in psychology, his "suggestiveness," and the influences themselves "suggestions"—social suggestions. These influences differ in different communities, as we so often remark. The Turk learns to live in a very different system of relations of "give and take" from ours, and ours differ as much from those of the Chinese. All that is characteristic of the race or tribe or group or family—all this sinks into the child and youth by his simple presence there in it. He is suggestible, and here are the suggestions; he is made to inherit, and he inherits. So it makes no difference what his tribe or kindred be; let him be a learner by imitation, and he becomes in turn possessor and teacher.

An entire department of so-called genetic pyschology is being written on this topic—the mode and method of the child's learning to be a man and a social man. I need not dwell upon it further here. But the case becomes more interesting still when we give the matter another turn, and say that in this learning all the members of society agree; all *must be born to learn the same things*. They enter, if so be that they do, into the same social in-

heritance. This again seems like a commonplace remark enough, but certain things flow from it. Each member of society gives and gets the same set of social suggestions, the differences being the degree of progress each has made, and the degree of faithfulness with which each reflects what he has before received. This last difference is, again, a phenomenon of variation and brings us back to the genius; but I wish to neglect him a little longer, in order to point out another fact which is fundamental to what is distinctive in this paper.

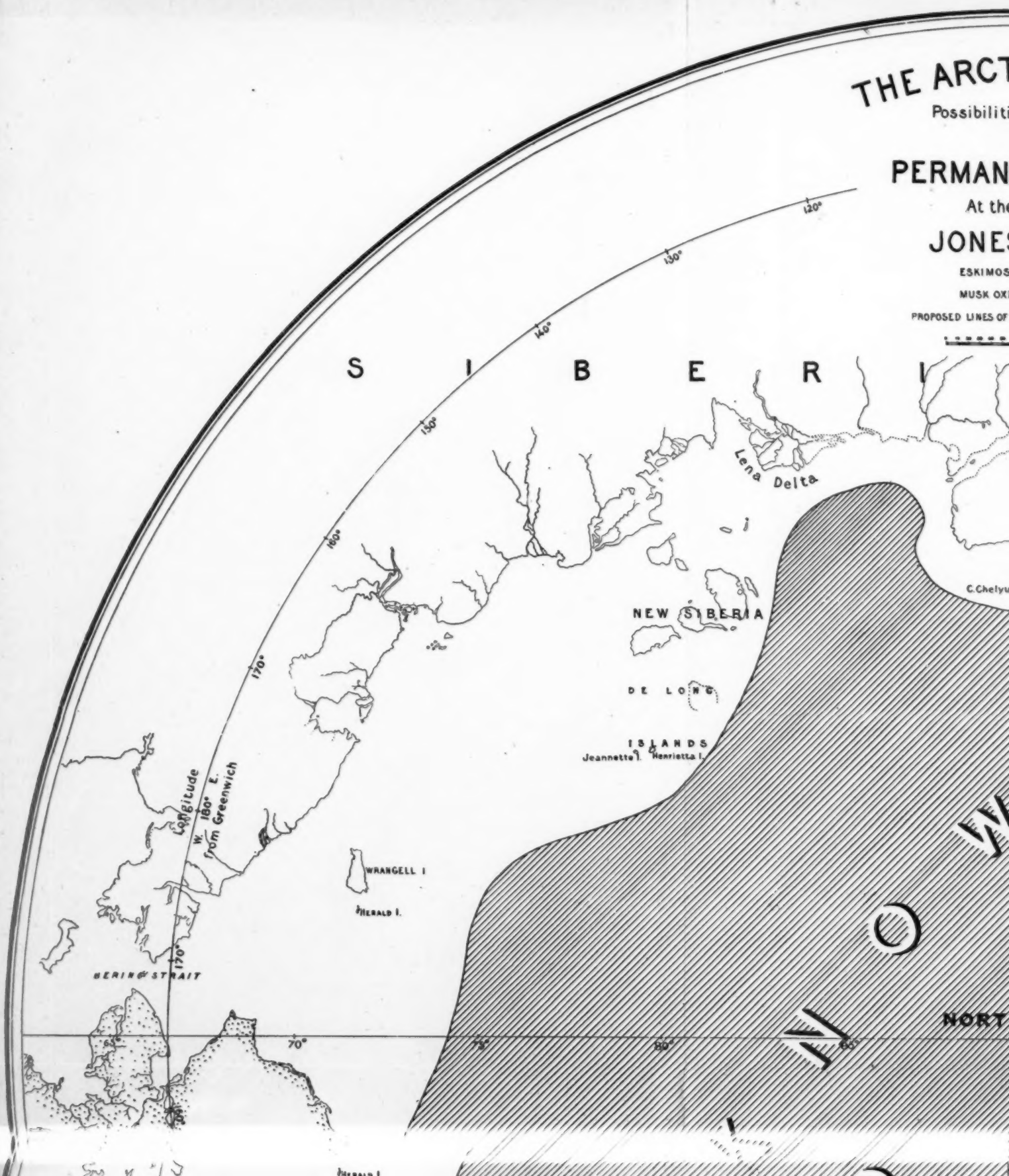
There grows up, in all this give and take, in all the interchange of suggestions among you, me, and the other, an obscure sense of a certain social understanding about ourselves generally —a *Zeitgeist*, an atmosphere, a taste, or, in minor matters, a style. It is a very peculiar thing, this social spirit. The best way to understand that you have it, and something of what it is, is to get into a circle in which it is different. The common phrase "fish out of water" is often heard in reference to it. But that does not serve for science. And the next best thing that I can do in the way of rendering it is to appeal to another word which has a popular sense, the word *judgment*. Let us say that there exists in every society a general system of values, found in social usages, conventions, institutions, and formulas, and that our judgments of social life are founded on our habitual recognition of these values, and of the arrangement of them which has become more or less fixed in our society. For example, to say "I am glad to see you" to a disagreeable neighbor shows good social judgment in a small matter; not to quarrel with the homœopathic enthusiast who meets you in the street and wishes to doctor your rheumatism out of a symptom book, that is good judgment. In short, the man gets to show more and more, as he grows up from childhood, a certain good judgment; and his good judgment is also the good judgment of his social set, community, or nation. The psychologist might prefer to say that a man "feels" this; perhaps it would be better for psychological readers to say simply that he has a "sense" of it; but the popular use of the word "judgment" fits so accurately into the line of distinctions I am making that I shall adhere to it. And so we reach the general position that the eligible candidate for social life must have good judgment as represented by the common standards of judgment of his people.

It may be doubted, however, by some of my readers whether this sense of social values called judgment is the outcome of suggestion operating throughout the term of one's social education. This is an essential point, and I must just assume it. Its consideration falls under the method of the child's learning, which I have referred to as too great a topic to treat in this article.

Yet I may say that it will appear true, I trust, to any one who may take the pains to observe the child's tentative endeavors to act up to social usages in the family and school. One may then actually see the growth of the sort of judgment which I am describing. Psychologists are coming to see that even his sense of his own personal self is a gradual attainment, achieved by the child through his imitative responses to his personal environment. His thought of himself is an interpretation of his thought of others, and his thought of another is due to further accommodation of his active processes to changes in his thought of a possible self. And around this fundamental movement in his personal growth all the values of his life have their play. So I say that his sense of truth in the social relationships of his environment is the outcome of his very gradual learning of his personal place in these relationships.

We reach the conclusion, therefore, from this part of our study, that the socially unfit person is the person of poor judgment. He may have learned a great deal; he may in the main reproduce the activities required by his social tradition; but with it all he is to a degree out of joint with the general system of estimated values by which society is held together. This may be shown to be true even of the pronounced types of unsocial individuals whom we had occasion to speak of at the outset. The criminal is a man of poor judgment. He may be more than this, it is true. He may have a bad strain of heredity, what the theologians call "original sin"; he then is an "habitual criminal" in Lombroso's distinction of types, and his own sense of his failure to accept the teachings of society may be quite absent, since crime is so normal to him. But the fact remains that in his judgment he is mistaken; his normal is not society's normal. He has failed to be educated in the judgments of his fellows, however besides and however more deeply he may have failed. Or, again, the criminal may commit crime simply because he is carried away in an eddy of good companionship, which represents a temporary current of social life; or his nervous energies may be overtaxed temporarily or drained of their strength, so that his education in social judgment is forgotten: he is then the "occasional" criminal. It is true of him also that while he is a criminal he has lost his balance, has yielded to temptation, has gratified private impulse at the expense of social sanity; all this shows the lack of that sustaining force of social consciousness which represents the level of righteousness in his time and place. Then, as to the idiot, the imbecile, the insane, they, too, have no good judgment, for the very adequate but pitiful reason that they have no judgment at all.

[*To be continued.*]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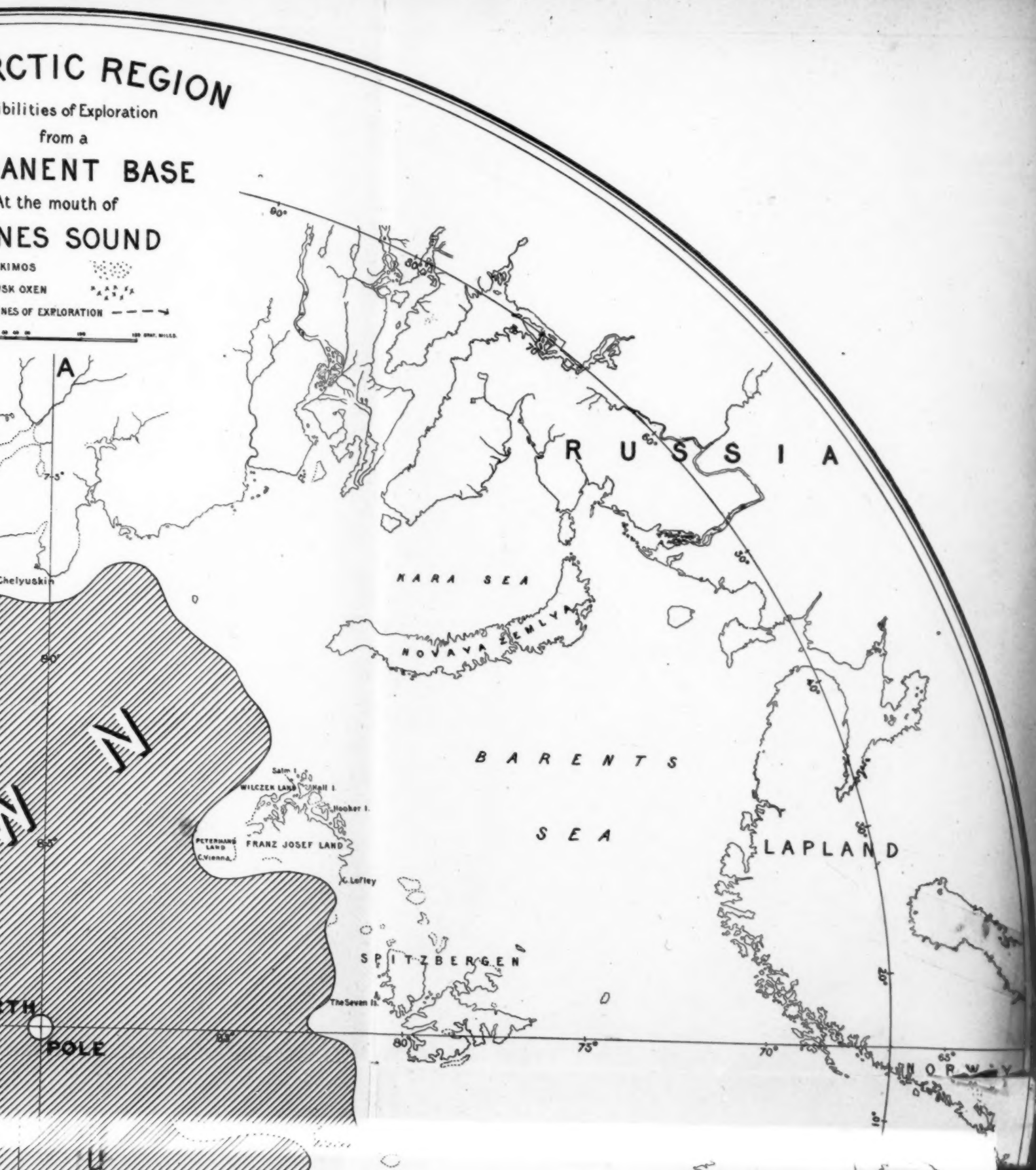
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C. Alexander
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ICELAND
Cary Ids.
Saunders I.
C. Melville
C. York
MELVILLE BAY
Cobourg Id.
Horsburg (Base of Operations)
BAFFIN
Upernivik
BAY
Homeward track of Whaling Steamers Sept. Oct.
Outward track of Whaling Steamers May, June
Christianshaab
C. Rapid
C. Kater
DAVIS
STRAIT
C. Searle
Old Sukkertop
C. Walsingham
Godthaab Fd.
Arctic Circle
John B. Terbert.

PROPOSED SYSTEM OF CONTINUOUS POLAR EXPLORATION.

By ROBERT STEIN,
UNITED STATES GEOLOGICAL SURVEY.

THE objects of polar exploration are fourfold:

1. COMMERCE.—According to General Greely, whaling has contributed over six hundred and eighty million dollars to the wealth of Holland, England, and the United States. Exploration will probably reveal new whaling grounds. *If treated with some forbearance,* the whale will restock the Arctic Ocean. Forbearance will restore the wealth in reindeer, which, with musk oxen, foxes, bears, seals, walrus, and narwhal, will supply desirable commodities. The known deposits of guano and valuable minerals may eventually be utilized, and others will be discovered. Alaska may not be the only gold-bearing arctic land.

2. SCIENTIFIC RESEARCH.—To ascertain with greater precision the shape, size, and density of the earth, the astronomer's base of measures, and thus render the science of surveying more accurate, ten pendulum observations near the unknown extreme of the arc are worth a hundred elsewhere. Observations on magnetism, especially near the magnetic pole, will benefit the thousands of ocean vessels which largely depend for their safety on the precision with which the compass can be interpreted. To the meteorologist the arctic is of special importance, because it presents the extremes of a world-embracing system, each of whose parts affects every other. Tides and currents are similarly interdependent. The aurora can best be studied where it is most common and most fully developed. Observations on the character and behavior of plants and animals under the unique conditions of the arctic will give to the student of organic life a more thorough mastery of his problems. To that end the hydrography must be known (depth of sea, temperature, water movement, sea bottom, salinity, light). The arctic affords the best facilities for studying one set of geologic forces (glaciers, icebergs, frost fissuring) in their extreme manifestation. The condition of the earth in past geologic epochs will not be fully known until the strata of the arctic lands have been mapped. To the paleontologist the arctic has already yielded most valuable information in the fossil evidence of a mild climate. Lockwood and Brainard found the slopes of western Grinnell Land studded with large petrified tree stumps. These and similar fossils, precious to museums or geologic cabinets, can probably be reached by way of Hayes Sound. To the ethnologist the Eskimos represent a phase of human life without a parallel. Museums need collections to illustrate these

lines of research. Thus the objects sought are well defined; but, apart from this, the very fact that there exists an unknown area of over a million square miles creates the duty to explore it, for two reasons: First, every new fact recorded, every misconception corrected, expands the mental horizon, gives additional power to the mind, and shuts off possible sources of error—an ounce of fact being worth a ton of speculation; second, every fact is part of a network, and as new facts are observed and correlated they constantly throw light on others, and presently group themselves into fruitful combinations. The most important discoveries have been made by men seeking simply to find out new facts, without regard to their consequences, or, rather, with the conviction, drawn from past experience, that no fact is without its useful consequence, and that therefore it would be a dereliction of duty to neglect any fact within reach. Think of Volta, Galvani, Oersted, Faraday, Crookes, Hertz, Röntgen! "Shall the northern limit of America remain unknown?" is a question which appeals to every American, even though he can not tell why. It may safely be said that there is nowhere a more assured prospect of filling many awkward gaps in scientific systems than in the arctic. If it be objected that this research should be postponed to a time when it can be done safely and economically, the answer is that this time has arrived.

3. OUTING.—For the tourist, the arctic, with its marvelous scenery, its inspiriting climate, free from colds and fevers, quickly doubling appetite, vigor, and endurance (as testified unanimously by whalers and explorers), is at least equal to Yellowstone Park or the Alps. The Hamburg-American line already sends an excursion steamer to Spitzbergen. "The northern limit of phthisis" in Berghaus's Physical Atlas may be a message of hope to many a stricken home.

4. HONOR.—Only hypocrisy can say that it does not desire the world's applause; only ignorance can say that the world proportions its applause to service rendered. Nothing arouses popular interest and wins popular homage more readily than successful arctic exploration. Supposing that this indicates no great discernment in the public, that does not alter the fact that a popular reputation is one of the most precious of human possessions—a capital enabling its possessor to apply his labor in any direction with vastly increased efficiency. If it is proper to strive for a capital in money, it is at least equally proper to strive for a capital in fame. And if fame be won by rendering important resources available, securing a vast array of scientific facts and giving access to unparalleled wonders, will it not be as fairly earned as many kinds which pass unchallenged?

He who understands the bearing of scientific facts knows

them to be worth more to humanity than tons of whalebone or ingots of gold; and as no reproach is cast on those who risk their lives for money, one might justify even the risk of life for scientific research in the arctic. But there is no need of this. Every careful student knows that in most cases the work involved no risk nor even greater hardship than is welcomed by an active man. Dr. Boas spent a year in Baffin Land in comfort and safety, traveling hundreds of miles, with Eskimo guides or alone, living mostly on the game of the country, and bringing back an unprecedented harvest of scientific facts, at a cost of seven hundred dollars. Considering the desultory character of most of the past work, the wonder is that disasters have been so few. Each explorer had to proceed independently to formulate his plan from book knowledge; inquire for means to obtain outfit and transportation; knock at a hundred doors before he met his patron; gather a party of novices; then start out with the haunting consciousness that, if he failed to accomplish anything in the limited time at his disposal, he would not have another chance. After returning he was generally unable, owing to the expensive methods of the past, to take the field again; his companions, with their precious experience, scattered over the world. The next expedition had to go through the same process. Could any business, say farming, be profitably conducted if the farm was worked one year and then abandoned for ten years?

"Arctic exploration," says Mr. Peary, "must, like anything else, be made a *business* and carried on from year to year, profiting by each added item of experience, taking advantage of every occurring opportunity." By doing the easiest and safest work first, the next will be made easier; and when a corps of experts has been developed, the list of difficult tasks will dwindle to very little. Lockwood and Brainard, in 1883, accomplished in six days a distance which it had taken them twenty-two days to accomplish the year before. "Hazardous expeditions into the open ocean," says Dr. Boas, "without the shelter of land and without any line of retreat, such as De Long's expedition, must be abandoned, as they will almost always end in disaster. Progress must be made cautiously and founded on the discoveries and experiences of past expeditions. It is only thus that scientific results can be obtained."

The expedition to Jones Sound, planned for 1897, is intended to initiate a system of continuous arctic exploration. Its object is to be the scientific research above indicated, and to this all else will be subordinated. Special attention will be paid to geology. Disasters having been plainly due to lack of a secure and always accessible base, the first object will be the establishment of a base at the mouth of Jones Sound, which Julius von Payer calls "the

one spot most suitable for such a base."* Being in assured annual communication through the Scotch and Newfoundland whalers, a well-housed and well-provisioned party, with some Eskimo families, will be as safe there as anywhere on earth, and will have before it a field unequaled in richness and extent. To the north, the west coasts of Ellesmere Land and Grinnell Land are to be explored; to the northwest, the triangle between those coasts and the Parry Islands is to be rescued from the unknown; to the west, the interior of North Devon is an interesting problem; to the southwest, Prince Regent Inlet *may* present an avenue to the magnetic pole; to the south, Baffin Land—with its Eskimo settlements, its herds of reindeer, its wealth in fishes and birds, its fossils and minerals—offers a tempting field, larger than the British Isles. Even Greenland may not be beyond the sphere of that strategic point.

Such a system, once initiated, will cost very little. Lecturing tours and the sale of collections will defray a large part of the cost. Considering the enormous sums spent on arctic exploration in the past by governments and by individuals, it seems probable that when the system is once in running order it will not lack patrons. The cost of the initial expedition is estimated at five thousand dollars. Much smaller sums will probably suffice in subsequent years.

OPINIONS.

Mr. Stein's plan is to establish a permanent station at the entrance of Jones Sound, to be occupied by from four to six white men and several Eskimo families, and from there carry on systematic scientific explorations northward, northwestward, westward, and southward as far as can be done with safety.

This plan is justly called by Julius von Payer "the best imaginable," for the reason that—

1. It is one of the safest, because its base station is annually reached by the whaling steamers.

2. It promises extensive scientific results, because that base gives access to a wide and rich field.

3. It is the cheapest, because of the possibility of utilizing the whalers as means of transportation.

4. It avoids hurry, which is a great source of danger and of imperfect work.

5. It permits the utilization of experience, allowing the same force to remain in the field for several years and to train their successors.

The main object of the first season's work will be the installation of the party. From my experience I am convinced that this initial work is prac-

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* The advantages of the Jones Sound route were pointed out by Dr. Boas in 1887, and by Elisée Reclus in 1890. A gradual and systematic advance has been advocated by many geographers.

tically free from risk, especially since Eskimos are to be employed. (R. E. Peary, civil engineer, U. S. Navy.)

It is Mr. Robert Stein's merit to have called attention to the remarkable fact that the most northern portion of our continent has so far remained unexplored, not on account of the inherent difficulties of access, but on account of historical facts which directed the attention of explorers to Lancaster Sound and its western continuation, and to Smith Sound and its northern continuation. All the facts that are known—and these are quite numerous—indicate that the northernmost portion of the arctic American archipelago can be reached without danger and can be explored with comparative ease.

Mr. Stein points out that the point of attack is Jones Sound, which has so far been entirely neglected by explorers. Profiting by previous experience, Mr. Stein proposes to establish a station at the entrance of Jones Sound, thus giving his operations the necessary security and practically excluding all danger of serious accidents. The entrance of Jones Sound is visited annually by whalers, who will keep the explorers in contact with the civilized world, and who can furnish supplies and help if needed. There is no doubt that a small number of scientists, supported by a few Eskimo families, will be able to thoroughly explore the outlines of all the unknown islands and bring home material results in all branches of natural science, and that they may add important observations on the physical conditions of the arctic zone. The field of exploration has the immeasurable advantage that it can be easily reached either by a special vessel or by means of whalers; that exploration is, one might say, absolutely safe; and that it is certain to yield results which will rank with the best achievements in arctic explorations.

It is Mr. Stein's intention to confine the first season's work to the establishment of a base station and the exploration of its immediate vicinity. It is his plan to engage the help of a number of Eskimos, and to limit the party to from four to six scientists. The experience of C. F. Hall, of Schwatka, and my own proves that such work is practically free from risks of any kind, and I do not hesitate to express my conviction that even the first year's work will amply repay the expense incurred in fitting out the expedition. (Dr. Franz Boas, explorer of Baffin Land.)

Your committee believe that this expedition is thoroughly safe and practicable; that it is desirable for scientific purposes; and that no part of the arctic regions gives promise of greater opportunities for extensive discoveries with a minimum of danger, hardship, and expense. (National Geographic Society, Washington, D. C.)

Whereas a systematic exploration of Ellesmere Land is projected, always within easy reach of a base of supplies: *resolved*, that the Anthropological Society of Washington heartily indorse both the exploration and the plan of operations proposed by Mr. Robert Stein.

The west coast of Ellesmere Land is, in my opinion, the one field of exploration in all the arctic that promises the largest results with the least amount of labor and danger. (General A. W. Greely, U. S. Army.)

I am pleased to see you lay so much stress on the one point on which I have always insisted—that no step should be taken in arctic exploration

until you know that your depot of provisions is actually established. (Commodore G. W. Melville, U. S. Navy.)

An expedition ought to provide for a successful retreat. This you have done by placing your supply depot in the line of the Scotch whaling vessels. There can be no question but that the region which you propose to explore is rich in animal life. In 1872 and 1873, at Lifeboat Cove, Eskimos told me that west of the mountains there were large quantities of deer and musk oxen. (R. W. D. Bryan, astronomer to Hall's Polaris expedition.)

I consider the exploration of the west cost of Ellesmere Land by the mode suggested in your paper not only entirely practicable but certain to obtain most valuable results with the minimum expenditure of money. (Colonel H. W. Feilden, naturalist to the Nares expedition.)

Stein is evidently on the right track. (Admiral Sir George S. Nares, commander of the British expedition of 1875–'76.)

I hail with delight your plan of systematic exploration of the arctic lands. Since it looks forward to an indefinite future, you can wait quietly till the work grows of itself, not only areally, but also in minuteness. (Dr. A. Supan, editor Petermann's Mitteilungen.)

I congratulate you on your selection of Jones Sound as the route of advance, since that is a far less dangerous avenue than many others. (Elisée Reclus, author of Nouvelle Géographie Universelle)

The most important idea in your plan, and one which will mark a new epoch in arctic exploration, is the idea of a permanent camp at the entrance of Jones Sound, where it will be in constant communication with the outer world through the whalers. The wonder is that so simple and inexpensive a measure was not thought of long ago. Had it been adopted, say fifty years ago, it is entirely probable that arctic history since then would have remained unclouded by a single disaster. (Lieutenant D. L. Brainard, U. S. Army, of the Greely party, who, with Lockwood, reached the highest north ever attained, 83° 24·5′.)

Your project is in every way well conceived, and will no doubt yield the best results. Attempts to reach the pole have not met with results commensurate to the efforts made. Far more fruitful to science is the methodical exploration of an arctic land. The American archipelago is as yet unknown to the west of Ellesmere Land. To American naturalists belongs the task of revealing to science this *terra incognita*, and your pro ject seems to me to be the most rational method. (Charles Rabot, explorer of Lapland, Spitzbergen, Iceland, and Greenland.)

You have hit upon one of the best routes for further discovery, and I am pleased to see that you are impressed with the necessity for a safe depot. (Clements R. Markham, C. B , President Royal Geographical Society of London.)

Mr. Koldewey, Councilor to the Admiralty, is of opinion that your project, which is well worked out in all its details, deserves to be received with interest by all friends of polar research. (Geographic Society of Hamburg.) (Captain Koldewey commanded the two German arctic expeditions of 1868 and 1869.)

I must confess the most active sympathy with the objects in view in all polar research, and I am convinced that the observations of physical phenomena there are to be ultimately of much practical benefit to us in these lower zones in our commerce and in the safety of our lives upon the high seas; but, unless systematically organized and continued through a series of years, we may expect small results. (Commander W. S. Schley, U. S. Navy, the rescuer of Greely.)

There is a line of possible discovery of the utmost importance lying between the Miocene deposits and the Pleistocene glaciation—viz., the finding of Pliocene beds that indicate the climatic conditions of the region just preceding the glaciation. All deposits later than the fossiliferous Miocene possess extreme interest. (Dr. T. C. Chamberlin, Professor of Geology, Chicago University, formerly President University of Wisconsin, and Chief of Division of Glacial Geology, United States Geological Survey.)

The Board of Managers of the Imperial Royal Geographic Society of Vienna has carefully examined Robert Stein's project of continuous polar exploration, and welcomes it with the utmost satisfaction. In the domains of oceanography, meteorology, terrestrial magnetism, the determination of gravity, plant and animal life, a new expedition would be of high scientific importance. For this purpose the plan designed and elaborated by Mr. Robert Stein seems especially suitable. At the request of the society, the well-known explorer, Julius von Payer, has also expressed his opinion.

A "secure base of operations" can only be had on land, and even there only at a few points in the polar region. It is the merit of Mr. Stein to have discovered the one spot most suitable for such a base. Mr. Stein's plan has my full approval, and, for geographic exploration in the far north, it is thus far the best imaginable. (Lieutenant Julius von Payer, explorer of Franz Josef Land.)

ON OUR BANKING SYSTEM.

By LOGAN G. McPHERSON.

IT is not to be supposed that many of the heads of the six million families in the United States whose incomes are less than six hundred dollars a year ever have in their possession more than a few dollars that are not required for immediate needs. A considerable number of those having larger incomes frequently are in possession of money which they are not obliged to spend at once, and merchants and manufacturers and others who direct on a large scale the efforts of many employees are frequently in possession of considerable sums which they do not immediately need to use.

Especially among English-speaking people has grown the custom of depositing such money in banks. Primary and elementary points of the banking problem are therefore the provision of receptacles for money that will withstand the forces of Nature and the assault of thieves; the securing of custodians who are

honest and competent to receive and record deposits and to make payments with accuracy. That the strong and well-guarded vaults of modern banks meet the first of these points is evidenced by the decreasing list of bank robberies that are accomplished by physical force. The examination of bank employees' character, that has become the more searching and rigid as the operations of guarantee companies have extended, is causing defalcations through the direct stealing of funds to become constantly fewer.

As banks have become more numerous, the use of checks has increased. Between office and store, factory and warehouse, bank and bank, city and city, millions of these pieces of paper are continually in transit, furthering the exchange of human effort. The interlinking of banks as correspondents and the growth of clearing houses have formed a mechanism whereby their payment is effected with celerity.

But the actual deposits of a bank are increased by the proceeds of loans which it makes and which are frequently placed to the credit of the borrower the same as though money had actually been deposited by him. For example: A bank discounts a note from A to B at sixty days for one thousand dollars. The proceeds, amounting to nine hundred and ninety dollars, may not be instantly needed by B; the amount is placed to his credit for him to check against—that is, nine hundred and ninety dollars is placed to his credit on the books of the bank. As his checks come in he is charged with their amount on the books of the bank. In this way he obtains from the bank the use of nine hundred and ninety dollars; or, to speak more accurately, the bank is the guarantor of representatives of value issued by him to the extent of nine hundred and ninety dollars. He has deposited no money. What he has deposited has been a promissory note—that is, a promise to produce the result of human effort of which he can dispose for at least the value of the note. As a bank's profits are largely made by discounting notes, a very considerable portion of the checks issued against every bank, therefore, are not drawn against money deposited in it, but against credits in its books, which are based upon the assurance of the forthcoming of the result of human effort. And therefore a vast proportion of all the checks that flit between store and office, city and city, are based, not upon cash directly, but upon the guarantee of a bank that it will accept checks to the value of the result of human effort, the assurance of the production of which has been discounted or purchased by it and held as the basis for its guarantee.

In the case specified, the exhaustion of his credit by B might be somewhat as follows: At the end of the week, to pay his employees, he may draw two hundred dollars from the bank. In this instance the bank advances to him out of that portion of its

deposits in actual money which it retains to meet current demands, coins, or circulating notes, to the amount of two hundred dollars. B may have employed C, a contractor, to make some repairs at his place of business, and he gives C a check on the bank for ninety dollars. C also has an account at the bank and deposits the check to his credit. The bank on its books charges B with ninety dollars and credits C with ninety dollars. B's debt to C has been paid without the use of money at all, the bank, in this instance, acting as a register of the exchange of human effort. B may have purchased goods in New York from X Y & Co. to the value of three hundred dollars. He delivers a check to his bank for that amount, and the bank delivers to him a draft on its correspondent bank in New York for three hundred dollars. B mails the draft to X Y & Co., who have an account at the bank on which it is drawn, and deposit it in that bank to their credit. This bank charges the original bank on its books with three hundred dollars, and credits X Y & Co. on its books with three hundred dollars. No money has been used in the entire transaction. Representatives of value based upon the note of A to B have caused the transfer of credits in the books of the original bank and in the books of the New York bank.

These instances indicate the manner in which, by the aid of the banking system, the exchange of the results of human effort is promoted to an extent far transcending the possibilities of exchange effected only by the use of coins or by the direct representatives of coins. By means of checks and drafts based on book credits in banks that are based on the assurance of the result of human effort as given by promissory notes, a very considerable portion of the commerce of civilization is forwarded, the proportion of exchanges effected by coins or the direct representatives of coins being in constantly decreasing ratio to the total value of exchanges. But, as when there is a scarcity of coin among the members of a race who have progressed to the use of coin, the exchange of effort between them is hindered and reverts to barter; as, when there becomes a scarcity of circulating notes among a nation accustomed to their use, commerce and manufacturing are restricted because, in the absence of other expedients, exchanges are necessarily conducted by coin, so in our banking development, when promissory notes and other securities are regarded with distrust by the banks upon which is devolving the most of the burden of directly or indirectly supplying the money needed in a community, there is a restriction of the exchange of human effort. Manufacture and commerce are retarded, and are forced to the exclusive use of coins or their direct representatives.

A most important point of the banking problem, therefore, is the regulation of discounts in such a manner that the commerce

of a nation may proceed with regularity, and its development be continuous and orderly.

Suppose that the money actually deposited in a bank amounts to one hundred thousand dollars. The bank knows from experience that it will not need to keep more than fifty thousand dollars of this to meet current demands, and therefore discounts notes to the extent of fifty thousand dollars. It has received money to the extent of one hundred thousand dollars, promises to pay money to the extent of fifty thousand dollars, and made itself liable to the extent of one hundred and fifty thousand dollars—that is, it is responsible for the payment of checks to an amount fifty per cent in excess of the amount of money which it has received. A definite amount of money is made the basis of liability for an amount one and a half times as great. But a bank discounts not only from its actual deposits, but also from its surplus of accumulated profit, and such of its capital as is not invested in real estate, bank building and fixtures. Suppose that the money actually deposited in a bank amounts to a hundred thousand dollars, that it has a surplus of two hundred thousand dollars, and its capital in excess of the amount invested in bonds, real estate, and banking house is two hundred thousand dollars; its funds available for discount thus amount to five hundred thousand dollars. As the only legal restriction upon the extent of its discounts is the requirement that it maintain a reserve in actual money amounting to twenty-five per cent of its deposits, it is obvious that by keeping on hand a hundred and fifty thousand dollars in actual money, its statement of deposits may show six hundred thousand dollars. Of this a hundred thousand dollars is actual money received as deposits and five hundred thousand dollars the proceeds of discounted notes. And thus it is evident how it is possible for by far the greater portion of the exchanges of the country to be effected by representatives of value based upon the assurance of the production of human effort contained in promissory notes. It must be recognized that this furthering of the exchange of the result of human effort may be of vast benefit to the public as a whole. For example, a Southern planter, with ripening acres of cotton, may not have the means wherewith to pay for the picking, cleaning, packing, and freight to the place of market. The proceeds of a note discounted at a bank will provide him with the necessary means, and he pays the note with the money obtained from the sale of the cotton. Likewise with an elevator owner in Chicago purchasing grain for export; or a coal operator of Pittsburg who desires to send fuel by river to the Southern, or by lake to the Northwestern markets; or a merchant with store, clerks, and knowledge of the wants of his section may give his notes for needed goods which he pays from the

proceeds of their sale; or a man, far-sighted, energetic, and careful, may perceive opportunity for profit if he could obtain the requisite material or the requisite tools or requisite help of other kinds. By having a note discounted, he obtains the requisite help and pays the note when the opportunity has been realized. In these instances, the discount of notes has contributed to the production and distribution of needed commodities. The producers have obtained profit, their employees have obtained wages; railways, vessels, and factories have been used with emolument to their owners and employees, and thousands of people have been placed in possession of food, fuel, and clothing.

But where there is a chance for profit, there also is a chance for loss. Flood may ruin the cotton crop, the markets may become so glutted that neither grain nor coal can be sold except at a greatly depreciated price; the merchant may be stricken in health; even the energetic, careful, and far-sighted man may have miscalculated his opportunity. In such cases, the result of human effort to the value of the notes may not be forthcoming; the assurance fail of performance; the notes can not be met. When representatives of value are based upon the promised result of human effort which does not materialize, they are worthless unless there is an ultimate basis of realized result. This realized result may be the property of signers or indorsers taken by the bank to make the value of the notes good; it may be of the capital or surplus of the bank or property of the stockholders who are liable for double the amount of their holdings; or, in the last resort, the loss falls upon individuals of the public in general.

Concerned, therefore, in the conduct of a bank are the stockholders, who profit by its prosperity and share its losses; the depositors, whose funds are in its custody, and the public in general; and an important phase of the banking problem is presented by three points: First, the necessity for a bank to keep on hand sufficient actual money wherewith to meet checks and drafts upon it that must be paid in actual money; second, the necessity for furthering the exchange of human effort and thereby making as large profits as possible by maintaining as large a line of discount at all times as may be prudent; third, to make no loans except upon adequate security.

When a bank discounts a note, its first consideration, of course, is the probability of the note being paid—that is, it desires to be reasonably sure that the transaction which the note covers will yield enough to cancel it. To this end it is obliged to rely largely upon the reputation for ability and honesty of the drawer and indorser, for it can not enter into the details of every transaction; but a general knowledge of prices and markets is useful, that it may not be overflooded with paper in any particular line of in-

dustry that may be offered by the oversanguine or the knavish. And the attempts to obtain discounts by the oversanguine and the knavish are not limited to the offer of paper in excess of the amount abundantly necessary to cover the movement in any particular line, but they frequently exchange notes, or in other ways obtain paper from a colleague which represents no legitimate business transaction, but by the discount of which they obtain needed funds.

As unpredicted circumstances may, at unforeseen times, cause unusual demands to be made upon a bank's deposits, it follows that a bank's loans should not be for long periods. In actual practice the average duration of notes is sixty days, and banks do not like to accept paper running longer than four months under any circumstances. Different notes coming due at different times bring into a bank day by day funds which it can use to discount new notes, or which it can retain in case of contingency requiring it to keep more money on hand than usual.

It is evident that a bank should not only be reasonably certain that the prospective exchange of effort which is the immediate cause of a loan should produce enough under ordinary conditions to cancel it, but that in case of contingency that is disastrous to the products immediately concerned the property of the signers and indorsers of the note not covered by other obligations be sufficient to liquidate it. But in these days, when a concern's property is not always visible and its incumbrances frequently concealed, a knowledge of its actual resources is difficult to obtain. It has happened that financial tricksters, by operations in several banks, knowledge of each of which has been kept from the others, have gained possession of funds far beyond the extent to which their resources entitle them, and in such a case, when any one bank suspects that it is being victimized, there is the temptation for it to conceal this knowledge from the other banks, that the unworthy customer may not be prevented from obtaining loans from them, wherewith he can repay the advances made by the bank which has begun to suspect him.

Perhaps the possibilities of unwholesome financiering which must finally result in loss to the banks and disturbance to all the communities concerned can best be illustrated by a definite example traced throughout its ramifications.

From a region rich in deposits of coal a railway extends to docks where coal is loaded into vessels for shipment to remote markets. A corporation controlled by a coal operator and the president of the railroad leases the docks, and engages in the purchase and shipment of coal. The railway is financially weak and the corporation without working capital. But the corporation buys large quantities of coal, giving four months' notes that ag-

gregate thousands of dollars in payment therefor; it gives four months' notes to the railroad company, aggregating thousands of dollars, in payment for the freight to the docks. The coal producers, to obtain ready money wherewith to run their mines, discount the notes obtained from the shipping company in their banks. The railroad company, to obtain ready money wherewith to meet its expenses, discounts the notes obtained from the coal company for freight in its different banks. It is the intention of the coal-shipping company to pay the notes for coal and the notes for freight when the coal which it has shipped is sold, but, finding it easy to issue notes, it buys and ships more coal than it can sell at remunerative prices, or for immediate returns, and when its notes are due it can not pay them all. To retain its credit with the coal producers, it pays the notes given to them, but it then can not pay all the notes given the railroad company. To meet the situation, the railroad company and the coal company exchange notes—that is, for example, suppose there be notes amounting to forty thousand dollars of the coal company to the railroad company coming due, and the coal company can pay but twenty thousand dollars. To meet the other twenty thousand dollars, which may be in two notes of ten thousand dollars each, which have been discounted by the railroad company at the P National and the Q National Banks, the railroad company gives the coal company two notes each for ten thousand dollars, and the coal company gives the railroad company two notes each for ten thousand dollars. One note of the coal company to the railroad company is discounted at the R National and the other at the S National Bank, and the treasurer of the railroad company, by that part of the transaction, is in possession of twenty thousand dollars, less the discount, which he badly needs to help pay interest on an overburden of bonds and bills and long-overdue wages to employees. One note of the railroad company to the coal company is discounted at the T National and the other at the U National Bank, and the proceeds, amounting to nearly twenty thousand dollars, in connection with the twenty thousand dollars already in its treasury, enable the coal company to meet the maturing notes to the railroad company for forty thousand dollars. The bank in which they are paid and the P National and Q National Banks at which they have been discounted have their belief in the ability of the coal company to meet its obligations strengthened, because it appears that the coal company is paying its notes. But this is not really so, for only one half of its original notes has been paid, and the notes exchanged, representing a liability of forty thousand dollars, leave the amount of discounts in various banks the same as when the original notes of forty thousand dollars of the coal company to the railroad company were discounted.

Suppose a similar transaction to be undergone with each of three sets of notes given by the coal company to the railroad company, each set originally amounting to forty thousand dollars. Instead of the original indebtedness of one hundred and twenty thousand dollars of the coal company to the railroad company, there is created by the exchange of notes for half that amount a joint liability of the coal company and the railroad company for one hundred and twenty thousand dollars. The coal has all been sold, but how is it with the coal company? How is it with the railroad company? And how is it with the banks that have discounted their notes?

The coal company continues business, giving new notes to coal producers for coal purchased, and new notes to the railroad company for freight. It is responsible not only for these notes, but for the previously issued notes. Because of this burden, it is obliged to increase its shipments of coal, and therefore to extend its markets. To do this it is obliged to undersell other coal-shipping companies, and therefore to dispose of coal at prices that do not yield enough to pay the notes given coal producers and the notes given the railroad company. The coal producers must be paid; but such remaining funds as it can obtain can not pay the increasing mass of notes given the railroad company, which mature at shorter and shorter intervals. There is more juggling of notes through banks, and the mutual liability of the coal company and the railroad company rolls up, like a big snowball pushed by schoolboys. The coal company must stop business or its shipments must increase. To stop is to acknowledge its bankruptcy. To increase shipments necessitates still further expansion of markets. It builds docks at the places of market, and organizes another company to operate them.

Although the stock of this receiving company is controlled by the same men that control the stock of the shipping company, the shipping company sells coal to it, and takes notes of the receiving company in payment therefor. These notes the shipping company discounts at banks. Notes have therefore been given by the shipping company to the coal producers for coal, and notes for the same coal have been given the shipping company by the receiving company. But the shipping company and the receiving company are controlled by the same men, and neither have working capital. The notes can not be met. There is more juggling through the banks, and the snowball grows. The shipping company must sell coal; the receiving company must sell coal. They cut prices; their competitors cut prices to retain their trade. The cutting continues until the wages of the miners who dig coal are cut; they are cut and cut. Coal is piled up on the docks. A great panic sweeps over the country. The shutting down of mills

and factories diminishes the use of coal. The traffic of the railroads falls off, and their locomotives do not burn so much fuel. There is an oversupply of coal, and the miners, whose wages have been reduced to a starvation basis, are without work even at those wages. All of them are poor, and the most of them are ignorant of the remote sources of the wrongs that are undoing them. Their discontent grows, and they strike. Their children are without shoes, and their stomachs are empty. Their discontent gives rise to mutterings. Here a coal tipple is burned, there an operator mobbed. The operators employ deputy sheriffs to protect their property, and threaten to call on the Governor for the aid of the militia in preserving peace. The miners are whipped and return to work.

The railroad company and the shipping company and the receiving company push the growing snowball of their indebtedness before them. By juggling, twisting, scheming, and the manipulations through the banks they are kept afloat.

What finally happens? The railroad company, overburdened with debts, and robbed by its officers, goes into the hands of a receiver.

The great snowball of indebtedness rests upon the coal company; its notes are scattered far and wide in the banks that have discounted them. What can the banks do? Get judgment on the notes and take the property of the coal company. But the coal company owns next to nothing. Its docks are leased, its cars are leased, its coal land is leased; the lessors have the first claim, the banks would get nothing. What can the banks do? Allow the coal company to issue bonds, take bonds to the value of the notes which they hold, and allow the coal company to continue? If it has so lamentably failed in the past, what can be expected of the future? The banks are between the devil and the deep sea.

How did they get there? Because they discounted notes assuring the forthcoming of the result of human effort to the extent that the signers and indorsers failed to produce. Had the banks been fully alive to the conditions of the coal markets, they certainly would not, in the first place, have discounted notes covering supplies of coal that far exceeded the demand, and the sale of which affected the prosperity of other coal companies to such an extent that cutting of prices finally reacted upon the prosperity of every community concerned in the coal industry. But, if it be urged that it is asking too much of any bank to keep track of the intricacies of every business, that a bank is safe in discounting the notes of concerns that always pay their notes, there is the reply that these concerns did not pay their notes. By manipulation they apparently paid them, and therefore the sys-

tem under which such manipulation is possible is fundamentally wrong.

Under the Canadian banking system, with its large banks, each having enormous capital and branches throughout the Dominion, it is practicable to enforce the rule of "one concern, one bank"; each customer must render a confidential statement to his bank from time to time of the exact condition of his affairs, of his assets and liabilities, and it is to the interest of his bank to accord him the fullest accommodation that his business will justify. Its enormous resources enable it to thus accommodate all its customers. It is evident that under such a system such juggling as that instanced in the foregoing illustration could not have been carried on. Many of the banks of the United States have blank forms which they submit to offerers of paper for discount, the filling up of which completely discloses the condition of their affairs, the extent of their assets and liabilities in every shape and form. Had such statements been required of the coal company and the railroad company by each of the banks before discounting their notes, the possibility of ruin entailed by their reckless procedure would certainly have been averted; but men, shrewd, plausible, and unscrupulous, have a way of quieting the fears of banks and evading inquiries that are searching.

Under the Canadian system the few banks, each with large capital and many branches, find it to their interest to employ as managers men of character, foresight, and ability, and they are not allowed to participate in any way in the borrowing of money from their banks. In the United States each city has its numerous banks, no one of them firmly connected in management with any other bank. The officials often are men of minds not of the broadest and judgment not of the most accurate, who have attained their positions, perhaps, through influence of one kind or another, and sometimes they are in direct partnership with the men who have offered paper to the bank for discount, the recommendation of action upon which comes within their province.

Under the Canadian system there are restrictions upon the amounts which directors of a bank can borrow, and their heavy liability for losses incurred by their bank leads them to exercise much caution in accepting paper. In the United States many bank directors seek their positions almost exclusively because of the facilities they thereby obtain for borrowing, and by their accommodating each other the legitimate business of the bank and the community is prone to suffer.

Under the Canadian system there is an examiner for each large bank, who inspects its operations from time to time to ascertain not only that its status is sound from a bookkeeping and

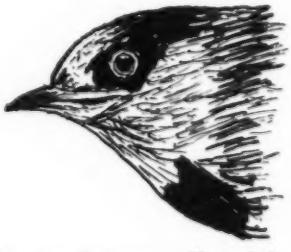
arithmetical standpoint, but that it grants discounts on sound principles, and that the discounted paper held by it is good. In the United States there are national bank examiners, but their duties do not embrace a thorough and rigid scrutiny of the soundness of notes discounted.

THE BIRDS AT DINNER.

By HARRIET E. RICHARDS.

WE think of the birds as dainty creatures, fit for poetry, song, and airy flights; but if we faithfully watch them a little, we shall discover that nearly their whole time and energy are devoted to securing their "daily bread."

Our familiar song birds begin their day about three in the morning; from that time until seven or eight in the evening the hours are mainly occupied in searching for food. Certainly they spend some time in making love, in building nests, in singing songs, but intermingled with it all is the constant demand for something to eat. Some fruit-eating birds are said to consume three times their own weight every day. Prof. Treadwell proved by experiment that a young robin will eat every day, and require



HEAD OF SWALLOW. Natural size.

CRESTED FLYCATCHER. Natural size.

it too for perfect development, more than his own weight of animal food. Think of human beings eating at that rate! Gormandizers, indeed! Think, too, of the labor of providing for, say, four such hungry, greedy little ones!

Scientific investigation has proved that nearly all birds feed their young on insects, worms, or some form of animal food, and also depend mainly on such food for themselves at that busy period of their lives, although at other seasons their favorite food may be grains and berries. Dr. Brewer says a pair of jays feed their young five hundred thousand caterpillars in a season, and that they will destroy one million eggs each winter; and that a chickadee will largely exceed these figures.

There are several reasons why birds require so much food. They are active creatures, being almost constantly in motion, some individuals traveling many miles every day. Of all animals, their blood is the warmest; their temperature is about five de-

Hairy Woodpecker.
Yellow-bellied Sapsucker.

grees higher than man's. This heat of the body is nicely protected by their covering of down and feathers, but it requires more food to make feathers than to make flesh or hair.

A tiny bird's body is a highly concentrated bit of nature, which is controlled by an intelligent and active brain that keeps his little system in such constant motion that it must be abun-

dantly nourished. If we notice carefully the beaks of all the birds we see, it will help us, by indicating their habits of feeding, to locate them in their families and thus lead us to their correct names. All the sparrows have short, stout beaks, well suited to cracking open seeds and grain, which is their usual food. The thrushes have a curved bill, convenient for holding worms and digging in the soil; they find most of their food on the gound, poking among the dead leaves and rubbish for grubs, beetles, and larvæ. Our robins, which are true thrushes, do valuable spring work in the garden and lawn pulling worms from the soil. Have you ever watched a robin at work? How he tugs and pulls when the worm is long and does not come easily! There is an

RUBY-THROATED HUMMING BIRD
(*Trochilus colubris*).

GOLDEN WINGED WARBLER.

RED-EYED VIREO. Natural size.

energy and a certain business air about him when at work which is very interesting.

The food of the thrushes is chiefly animal, although they like a few strawberries and cherries for dessert, which we ought to be very willing to allow them as a slight return for all the worms and insects they destroy for us. The warblers are almost exclusively insect-eating birds. A few of them hunt on the ground for their food, but as a family their place is high in the tree tops, searching among the foliage for the tiny insects, plant lice, and spiders that make their homes there. They are small birds, having slender beaks.

The tiny humming birds, with their long, needle-shaped bills, are well equipped for securing honey from the very heart of the trumpet flowers and honeysuckles. They find numerous small insects within the flower as well as honey. From a paragraph in a recent number of The Auk we might judge that spiders were a favorite food with them, a writer there telling us that he found

twelve spiders and many broken remnants of others in the gullet of a female humming bird that he dissected August 19, 1894. He remarks that "the gullet was also well filled with honey."

The swallows feed entirely on insects, securing them on the wing. To accomplish this successfully they are provided with

RED-BACKED SANDPIPER. Natural size.

CHIPPING SPARROW. Natural size.

broad, short bills and a mouth which opens very wide, really from eye to eye. The woodpeckers have large, chisel-like bills, which they put to constant use in securing their food, most of which they glean under dead bark on the trunks of trees. The tongues of the woodpeckers, excepting the sapsuckers, have little barbs on each side like the barbs of a fishhook; this little instrument, we may readily understand, proves very useful in capturing their prey. The sapsucker has a sort of brushlike arrangement at the end of the tongue which aids him in collecting his food. The woodpeckers feed mainly on insects, beetles, and grubs, and render us valuable service in destroying many pests; they also eat nuts and some fruit.

An interesting family of birds to observe when feeding are the flycatchers. Our kingbird is a familiar illustration of the family. They feed almost exclusively on insects in flight. They are cool-headed, businesslike birds, deciding to sit quietly on a perch until some pretty fly passes near; then, presto! a snap, and poor little fly is already in the flycatcher's gullet. There is no nervous uncertainty in a flycatcher's disposition, but quiet waiting till the decisive moment, then his sharp little bill clinches the winged creature in an instant.

Near my favorite window, on the branch of an apple tree, the tent caterpillars have had a nest for a number of years. I have never allowed the nest to be burned out or destroyed, choosing to leave it for a feeding place for the birds. It has been extremely interesting to notice the different birds around the nest, and their manner of attacking it. The yellow-throated vireos are the most frequent visitors; they find the worms a dainty feast. Often they thrust their tiny beaks into the sticky web and tear off bits

to take away for nest-building; sometimes it pulls hard, or they try to take too large a piece; then they will brace their feet, set their bodies, and tug with a vim; something has to give way, and very soon it is the sticky web; then away goes my yellow-throat, a happy conqueror.

The orioles are the next most frequent visitors. They peck fearlessly into the nest; so do the little flycatchers—the chebecs. The yellow warblers, robins, redstarts, and rose-breasted grosbeaks, and, of course, numerous English sparrows peck around the foliage near the nest and try a worm occasionally that has crawled from the nest, but they do not often trouble the nest itself.

Nature plans very beautifully for her creatures. Every bird has its food within reach of its own well-directed effort; but it remains for the bird to make the effort and secure the food. The structure of the bird's body—his beak, feet, feathers, length of neck—his manner of flight, his habits, and tastes, all are nicely planned for the little owner's daily quest for food.

A humming bird would not enjoy a sparrow's chubby beak, neither would the grosbeak find it easy to open pea pods or pick potato bugs with the humming bird's needlelike bill. The shore birds—the sandpipers and herons—would find it difficult to scale the trunk of a tree for their dinner, as do the nuthatches and woodpeckers, but their long, slender beaks deftly pierce the mud for snakes and worms, while the ducks find their large, flat beaks convenient for seizing and holding a frog.

The nocturnal birds, as the owls and whip-poor-wills, each possess interesting physical characteristics for securing their food

ORCHARD ORIOLE. Im. ♂ second year; natural size.

TONGUE OF WOODPECKER. Magnified.

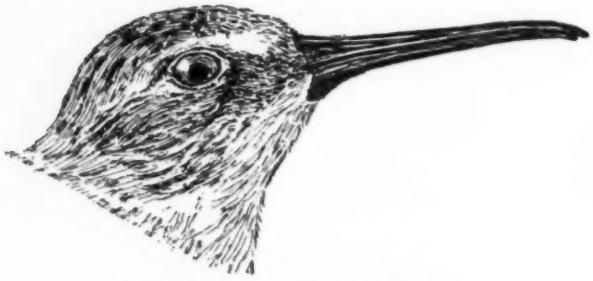
TONGUE OF SAPSUCKER. Magnified.

in the dark. When we have learned the tastes and habits of any bird, we shall see how perfectly he is equipped with an apparatus that would be an incumbrance to some neighbor bird, but to him is indispensable to life and comfort.

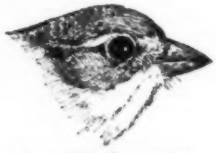
If we will study something of the birds—their structure, their

twelve spiders and many broken remnants of others in the gullet of a female humming bird that he dissected August 19, 1894. He remarks that "the gullet was also well filled with honey."

The swallows feed entirely on insects, securing them on the wing. To accomplish this successfully they are provided with



RED-BACKED SANDPIPER. Natural size.



CHIPPING SPARROW. Natural size.

broad, short bills and a mouth which opens very wide, really from eye to eye. The woodpeckers have large, chisel-like bills, which they put to constant use in securing their food, most of which they glean under dead bark on the trunks of trees. The tongues of the woodpeckers, excepting the sapsuckers, have little barbs on each side like the barbs of a fishhook; this little instrument, we may readily understand, proves very useful in capturing their prey. The sapsucker has a sort of brushlike arrangement at the end of the tongue which aids him in collecting his food. The woodpeckers feed mainly on insects, beetles, and grubs, and render us valuable service in destroying many pests; they also eat nuts and some fruit.

An interesting family of birds to observe when feeding are the flycatchers. Our kingbird is a familiar illustration of the family. They feed almost exclusively on insects in flight. They are cool-headed, businesslike birds, deciding to sit quietly on a perch until some pretty fly passes near; then, presto! a snap, and poor little fly is already in the flycatcher's gullet. There is no nervous uncertainty in a flycatcher's disposition, but quiet waiting till the decisive moment, then his sharp little bill clinches the winged creature in an instant.

Near my favorite window, on the branch of an apple tree, the tent caterpillars have had a nest for a number of years. I have never allowed the nest to be burned out or destroyed, choosing to leave it for a feeding place for the birds. It has been extremely interesting to notice the different birds around the nest, and their manner of attacking it. The yellow-throated vireos are the most frequent visitors; they find the worms a dainty feast. Often they thrust their tiny beaks into the sticky web and tear off bits

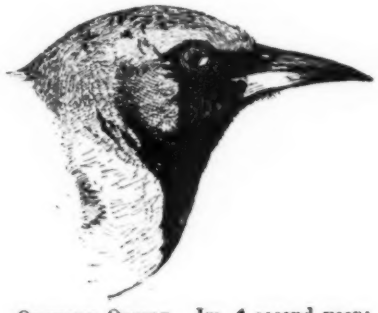
to take away for nest-building; sometimes it pulls hard, or they try to take too large a piece; then they will brace their feet, set their bodies, and tug with a vim; something has to give way, and very soon it is the sticky web; then away goes my yellow-throat, a happy conqueror.

The orioles are the next most frequent visitors. They peck fearlessly into the nest; so do the little flycatchers—the chebecs. The yellow warblers, robins, redstarts, and rose-breasted grosbeaks, and, of course, numerous English sparrows peck around the foliage near the nest and try a worm occasionally that has crawled from the nest, but they do not often trouble the nest itself.

Nature plans very beautifully for her creatures. Every bird has its food within reach of its own well-directed effort; but it remains for the bird to make the effort and secure the food. The structure of the bird's body—his beak, feet, feathers, length of neck—his manner of flight, his habits, and tastes, all are nicely planned for the little owner's daily quest for food.

A humming bird would not enjoy a sparrow's chubby beak, neither would the grosbeak find it easy to open pea pods or pick potato bugs with the humming bird's needlelike bill. The shore birds—the sandpipers and herons—would find it difficult to scale the trunk of a tree for their dinner, as do the nuthatches and woodpeckers, but their long, slender beaks deftly pierce the mud for snakes and worms, while the ducks find their large, flat beaks convenient for seizing and holding a frog.

The nocturnal birds, as the owls and whip-poor-wills, each possess interesting physical characteristics for securing their food



ORCHARD ORIOLE. Im. ♂ second year; natural size.

TONGUE OF WOODPECKER. Magnified.

TONGUE OF SAPSUCKER. Magnified.

in the dark. When we have learned the tastes and habits of any bird, we shall see how perfectly he is equipped with an apparatus that would be an incumbrance to some neighbor bird, but to him is indispensable to life and comfort.

If we will study something of the birds—their structure, their

habits, and their dispositions—we shall constantly be impressed with the practical wisdom of these little inhabitants of our gardens and forests, and be daily encouraged by their untiring industry and bright, sprightly ways.

SUGGESTION IN THERAPEUTICS.

By Prof. WILLIAM ROMAINE NEWBOLD.

IF there be any truth in the doctrines I have already put forth in these pages, it seems *a priori* probable that suggestion will prove useful in combating some of the many ills that flesh is heir to. The various devices for heightening suggestibility are simply devices for increasing the effects proper to any given mental state by removing from its path all obstacles. Among the effects of mental states are the production and prevention of other states and of movements, and there are many diseases which are characterized by disturbances of sensation, thought, or movement. Very often these disturbances are functional—that is, they can not be traced to any visible injury of the nervous system, and frequently appear and disappear in most unaccountable fashion. It does not seem improbable that in such cases suggestion might work effects worthy of serious consideration.

And in fact it does. Every physician knows that it does, even though he has never heard the word "suggestion," or laughs at the theories of Nancy. Instinctively every trained practitioner supports his remedies by suggestion, cheering the patient by word and look, pooh-poohing his fears, assuring him of a speedy recovery, and often, if he be somewhat wiser than common, expatiating upon the specific results expected from the dose now to be administered.

The movement known as Psychotherapeutics or Suggestive Therapeutics is an attempt to dissociate this element of medical practice from its concomitants in order to determine its value when taken by itself. What that value is I shall not venture to say. In all probability the advocates of the method—or some of them—exaggerate its efficacy, and doubtless the personality of the physician has much to do with its success. In one man's hands suggestion will work wonders; in those of another it is almost valueless. Yet the evidence is rapidly accumulating, and every year sees a greater consensus among those who have made the trial as to the limits within which it is of value.

I can not undertake in one short article to go into the details of the results reported by von Krafft-Ebing, von Schrenck-Notzing, Forel, Ladame, Moll, Wetterstrand, van Renterghem and

van Eeden, Liébeault, Bernheim, Janet, Bérillon, Pitres, de Jong, Bramwell, Lloyd Tuckey, Hamilton Osgood, and others, but I can say a few words as to the troubles in relieving which suggestion has been found useful.

In the first place, it will sometimes overcome insomnia. In the second, it has been used to restore to hysterical patients their lost sensations, but the restoration is usually but temporary. In the third, it may be used to destroy all sorts of disagreeable symptoms, especially neuralgic pains and headaches. It is possible to produce complete anæsthesia for surgical purposes in this way; but, as ether, chloroform, and cocaine are much more reliable, suggestion is seldom used. Dr. Wetterstrand, however, usually hypnotizes slightly before administering an anæsthetic; he has found that he can in this way get along with a much smaller amount of the drug, and also avoid the "violent" stage.

In the fourth place, suggestion is sometimes efficacious in cases of disordered ideation and morbid impulses. Mild melancholia, horror of food and of open spaces, insane doubt, homicidal and suicidal impulses, sexual perversion and inversion, dipsomania, morphinomania, fear of death, and others of the kind have been successfully treated by suggestion. But upon the more serious forms of mental disease it seldom has any effect.

In the fifth place, it is often of aid in motor disorders not dependent upon organic disease of the nervous system. Such are hysterical contractures, paralyses and convulsions, nervousness, chorea, sudden loss of voice, stammering, twitching of muscles, etc.

These are the troubles in which suggestion has been found most useful, but of course no one claims that it is a specific for them all. It often does good and never does harm; but sometimes it does no good, and at other times the improvement is but temporary. There is nothing very surprising in the fact that such troubles have sometimes been found amenable to suggestion. Although the effect ascribed to the mental state may be greater than we usually suppose such a state could produce, the difference is one of degree and not of kind. But I must now turn to a group of phenomena which seem at first glance to differ in kind as well as degree from anything with which we are familiar.

We usually conceive that the processes grouped under the word metabolism depend upon purely mechanical and chemical conditions, modified in some way, to be sure, by the fact that the body is alive and not dead, but still essentially physical and chemical. The word metabolism comes from a Greek word (μεταβολή) which means "exchange," and it designates the fact that

we suppose all the processes of nutrition and decay, secretion, assimilation, excretion, oxidation, etc., to be at bottom alike, and in the last analysis to consist in an exchange or substitution of atom for atom within the constituent molecules of the body.

Now, it is easily shown that this notion is erroneous, for the physical and chemical processes taking place within the body are not precisely like other such processes; they stand to some extent under the control of the nervous system. For example, the amount of heat evolved within the body is probably regulated by a center in the spinal cord. The nutrition of the voluntary muscles probably depends upon the functioning of certain cells in the anterior horns of the spinal cord, and if the latter are destroyed the muscles waste away. Dr. Darkschwitsch has recently published in the *Archiv für Psychiatrie* an elaborate study of certain forms of muscular atrophy complicated with painful disease of the joints. These frequently follow paralyses due to injury of the cortex, and he concludes that the metabolic changes probably result directly from the cortical injury and not from disuse of the affected limbs. I recollect seeing some time ago a patient of Dr. Charles K. Mills's who had had the left cortical center for the hand removed to cure an epilepsy. He had lost in consequence, as was to be expected, much of his power over the right arm and hand, and he had also lost, as was not to be expected, all the skin of his right hand. Dr. Mills told me he had several times seen localized metabolic disturbances follow lesion of that region of the cortex which controlled the muscles of the affected part.

Besides this probable direct control, the nervous system can affect metabolic processes indirectly through the blood supply. The distribution of the blood is regulated by the complex vasomotor mechanism which controls the force and rate of the heartbeat and the diameter of the arteries and arterioles; the entire system is controlled in turn by a center in the medulla. It acts for the most part reflexly, sending the blood tide with the greatest force to the organ that needs it most, but it can be affected in other ways.

Such facts are interesting, and they put it beyond question that the nervous system has to do with the processes of metabolism, but they do not show how those processes can be affected by the functioning of that part of the nervous system which underlies consciousness, or, to use my former phraseology, how mental states can control metabolism.

That some metabolic processes can be affected by mental states is well known. For example, the secretory and excretory processes can not only often be started and stopped in this way, but the chemical character of their products can be modified, as when

a sudden fit of anger makes a mother's milk poisonous to her child.*

In general, an emotional storm or even an emotional mood, if long continued, may have a profound effect upon the functioning of the body. The cheerful emotions favor health; the depressing emotions make the body fertile ground for the growth of disease germs. Yet even this admission does not bring one much nearer the point of interest; for, since the epoch-making discoveries of Prof. James, of Harvard, and Prof. Lange, of Copenhagen, it has been known that what we call an emotion is not the *cause* but the *feeling* of those extensive bodily changes which we regard as its expression, and to inquire into the effect of emotions upon metabolism would lead me too far afield into the general theory of emotion.

To account for the more remarkable effects of suggestion upon metabolism we are forced to a most extraordinary hypothesis, which may be thus stated:

The thought of any given bodily change, whether motor, vasomotor, or metabolic, tends to the actual production in the body of the change which that thought represents.

That this law is true of motor thoughts I think quite clearly proved. Of the vasomotor it is not so clearly true, but there is a considerable amount of evidence going to show that the blood tide can be to some extent directed by act of will by most persons, and by some persons to a much greater extent. The evidence for any control over the metabolic processes is very scanty. If the tendency exists, it must be latent in most persons, for we all know that I can not by thinking add a cubit to my stature or change the color of my beard. Yet, even though it be latent in most persons, it may exist in others, and I think the evidence for its existence is strong. The chief difficulty in accepting it lies in this: we know of no nervous mechanism by which such central processes can affect the body unless it be through the sensory nerves, and, according to our present physiology, sensory nerves can carry impulses in one direction only.

I can not explain these difficulties and shall not attempt to. I shall simply relate the more important bits of evidence which have been gathered since the 12th of May, 1885, when M. Focachon performed his first successful experiment under satisfactory conditions before the professors of the Medical School at Nancy. Most of this evidence is experimental and it deals with modifications of the skin only. I do not suppose that this fact proves that the control of thought over the skin is greater than that which it exercises over the internal organs, but merely that experiments

* Carpenter, Mental Physiology, § 566.

upon the skin are more satisfactory than those on other parts of the body, partly because their results are more manifest and partly because they are attended with less discomfort to the patient. They belong to two types: (1) those in which the modifications induced are chiefly vasomotor—redness, swelling, exudation of blood, etc.—but greater than one can usually produce by an act of will; and (2) those in which there is visible change in the tissue. It is quite possible that the latter are due in large part to vasomotor modifications, but we can not at present prove that such is the case. In connection with these experimental cases I shall introduce a few parallels derived from other sources to show their absolute identity of type.

The first case which I shall quote is reported by Dr. Biggs, of Lima, and is recorded by Mr. F. W. H. Myers in the Proceedings of the Society for Psychical Research, vol. vii, page 339. In three cases Dr. Biggs produced a red cross upon the skin by suggestion. His own account of the first of these cases, slightly abbreviated, is given as follows in a letter dated October 18, 1885:

"I put her into a magnetic or mesmeric sleep by laying my hand on her head for about a minute. I then said, 'Maria, do you hear me?' 'Yes.' 'Are you thoroughly magnetized?' 'Yes.' 'Now listen attentively: a cross is going to appear on your right forearm and remain there until I tell it to go away. Here is where it is to appear.' (I then described a cross with my forefinger on the inner side of her right forearm.) 'Have you understood what I have said to you?' 'Yes.' I then awakened her by two or three up-passes; for the next two or three days she seemed sulky and out of sorts, would now and then rub her right arm, over the place where the cross was to appear; when asked why she did this, she said there was an itching and she could not help scratching the place, although there was nothing to be seen that could cause the irritation. I then magnetized her as before, and asked, 'Do you recollect what I told you the other day about the cross that is to appear upon your arm?' 'Yes.' 'Will it appear?' 'Yes.' 'When?' 'In a few days.' 'Well, it must come out in three days; do you understand?' 'Yes.' By the time appointed a dusky red cross, four or five inches long and about three inches wide, made its appearance. At first we pretended not to notice this, although we could often see the lower part of it when her sleeve was partly rolled up in some of her duties in and about the house; she was our housemaid. It was only at intervals, when thrown into the magnetic sleep, that we could get a full view of the cross; never a word had been said to her about the cross in her waking moments, for some time, several weeks, until one day I pretended to have caught sight of the strange mark on her arm, and said:

'Why, Maria, what is the matter with your arm? Have you hurt it? What mark is this? Let me see; pull up your sleeve.' She did so with a slightly sulky, ashamed air. 'Why, it looks like a cross; where did you get this?' 'I don't know, sir.' 'How long has this been on your arm?' 'More than a month, sir.' 'Have you felt anything?' 'No, sir; only at one time I had a great deal of itching and burning, and a few days afterward this mark came out on my arm.' After this we frequently spoke to Maria about the cross, and when requested to she would roll up her sleeve and show it to visitors, although she always seemed reluctant to do so. Many months afterward she left our service, and in about two weeks she made her appearance at my office in town, asking me to remove the cross from her arm, as it attracted the notice of the family with whom she was now living, and she was much annoyed by the many questions asked her. I magnetized her, and then told her that the cross would disappear in a few days, and she would be no more troubled with it. I saw her a few days afterward at Salto; the cross had disappeared."

In another case Dr. Biggs caused a cross to appear every Friday on the chest for a period of nearly six months. These cases are not sufficiently well authenticated to make them of much value taken by themselves, but, in conjunction with the results got by other experimenters, they are worthy of consideration.

For example, Prof. Pierre Janet suggested to his hysterical patient Rose that he would put a mustard plaster upon her abdomen to relieve hysterical contractures of the stomach. "I found, some hours later," he says,* "a swollen mark, dark red in color, in the form of an elongated rectangle, but—odd detail—none of its angles were clearly marked, for they seemed neatly cut off. I remarked that the burn had an odd shape. 'Don't you know,' said she, 'that the corners of the Rigollot plasters are always cut off so that they won't hurt?'" Following up this hint, Prof. Janet suggested putting on a plaster shaped like a six-pointed star, and he got the corresponding burn. On the chest of another patient he produced an S in the same way. Prof. von Krafft-Ebing has done the same with his famous patient Ilma Szandor.†

Prof. Charcot's case of suggested œdema is even more curious, as it involved not merely vasomotor changes, but also a fall of temperature, and probably modified nutrition as well. It is reported by Dr. Levaillain.‡ "M. Charcot had presented two cases

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* L'Automatisme Psychologique, p. 166.

† Eine experimentelle Studie auf dem Gebiet des Hypnotismus. Stuttgart, 1889. English translation by C. G. Chaddock, M. D., New York, 1889.

‡ Revue de l'Hypnotisme, vol. iv, p. 354, June, 1890. Cf. also Mr. Myers, *op. cit.*, p. 337.

of hysterical blue œdema occupying the entire extremity of the upper limb and making the hands appear swollen, bluish, cold, contrasting in the highest degree in volume, temperature, and coloring with the hand of the opposite side. He then exhibited in the auditorium a patient suffering from major hysteria who was hypnotizable. The following suggestions had been given her during the hypnotic sleep for four or five days: She was told her right hand was puffing out, becoming larger than the other; that it was getting blue, becoming red, then violet; finally, that it was hard and was getting colder and colder. Under the influence of these suggestions, repeated at five or six hypnotic sittings, the right hand became enormous very rapidly, almost double the volume of the other; it was really much discolored and of a true cyanic tint; it was hard to the touch, and the finger would not sink into it; finally, its temperature was three degrees (centigrade) below the normal temperature of the rest of the body. In a word, it resembled in every respect the hand of another hysteric who was suffering from a spontaneous blue œdema. It was, then, possible to produce and localize in the hand by means of simple suggestions lasting disorders of nutrition and circulation of such a character that the hand became half again as large, more colored, and much colder than the other hand."

Another curious vasomotor phenomenon is the "bloody sweat." It is sometimes found occurring spontaneously without visible reference to mental states. Such a case is reported by Dr. Ernoul, of St. Malo.* A hysterical girl whom he observed had bleeding spots on various parts of her body which appeared and disappeared in most unaccountable fashion. A somewhat similar case was observed by Drs. Artigalas and Rémond,† in which the bleeding could be produced by suggestion. The patient was a young married woman, twenty-two years of age. She entered the hospital October 31, 1891, for various troubles requiring surgical treatment. Later she complained of pain in the ears, and had several hæmorrhages from them. On the 23d of November and the seven subsequent days she at times wept bloody tears. She called the doctors' attention to this on the 27th; they could find no injury in the eye, but learned that she had had in childhood frequent hæmorrhages from the nose and one from the stomach. A careful examination showed many hysterical symptoms. She was hypnotized, but it was not possible to check the bloody tears by direct suggestion; they could, however, be occasioned by suggestion at any time. "On December 1st, Prof. Artigalas put her again to sleep, and suggested to her that the hæmorrhages from the eye would not recur, but that she would bleed from the hollow

* Revue de l'Hypnotisme, iv, 283.

† *Op. cit.*, vi, 250.

of the left hand. A few minutes after being awakened she in fact had a hæmorrhage, or rather a bloody sweat, on the palm of the left hand. The phenomenon took place under our eyes without M. Artigalas leaving the patient and without any possibility of fraud. The skin was absolutely sound on the surface at the point which bled; the blood seemed to exude in the creases much as a profuse sweat would have done; one could not detect upon trial any appreciable modification of the integument. The hæmorrhage ceased upon washing the hand in cold water." The palmar hæmorrhages were then checked by suggestion.

Drs. Bourru, Burot, and Mabille have got even more curious phenomena in the case of their famous hysterical patient, Louis V——. They produced bleeding by suggestion from the nose, from designated points on the skin, and even fixed beforehand the hours at which the bleeding was to take place. On one occasion they heard him *give himself*, while in a secondary state, similar suggestions, and the blood appeared punctually on the spot indicated. Nothing could better demonstrate the subjective character of the agency that produces these inexplicable results.

These cases are precisely parallel to those of the so-called "stigmatics"—"saints" who bore upon their persons the marks of crucifixion. The hagiology of the Roman Catholic Church is full of them, and not a few have been observed in recent years. I will quote the case of one: Marie de Moerl, of Kaldern, in the Tyrol, became subject to ecstasy in 1832, she being then about twenty years of age. Generally the subject of her meditation was the passion of Jesus. "In the autumn of the same year her confessor perceived that the palms of her hands, where subsequently the marks of the crucifixion appeared, sank in, as if under the pressure of a body in half relief. At the same time the part became painful and frequently cramped. On the 2d of February, 1834, at the Feast of the Purification, he observed her wipe the middle of her hands with a towel and exhibit a childlike alarm at the blood which she perceived there. These marks soon showed themselves on her feet and her heart. They were nearly round, spreading a little in length, three or four lines in diameter, and seeming to pass through both hands and both feet. On Thursday night and Friday all these wounds shed drops of blood, ordinarily clear. On other evenings they were covered with a crust of dried blood." *

The well-known case of Louise Lateau was precisely similar. At the present time, according to newspaper accounts, a certain Mrs. Stuckenborg, of Louisville, Ky., presents the phenomena of

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* Brierre de Boismont, Hallucinations, Case 100. English translation, Philadelphia, 1853.

stigmatization. Dr. Hodgson told me he went to Louisville and endeavored to study the case, but found she was in the hands of the Roman Catholic authorities, and he was not allowed to examine her.

The ease with which warts can be "charmed away" by suggestion has long been known. I will quote two cases. The patient in the first case was my wife, then a little girl, and the account was written for me by her mother. "I remember it all perfectly. It was when E—— was about six years old, just before we went to Boston to live. She had had warts on her hands for over a year. They had spread until her hand was not only badly disfigured, but very painful, as they were apt to crack and bleed. Two physicians, both relatives of ours, had prescribed for them, and we had followed directions without success. We were in Lawrence, at M. P——'s. A lady came to tea, noticed the warts, and offered to remove them by a 'charm.' As I had once or twice been relieved in childhood in the same way, I was delighted at the offer. She went through some mummery, rubbing them and muttering something, I think, and then announced that they would be gone in a month. They were, every one. In a few days they began to dry up and disappear. So far as I can remember, she never had another. When I was a child there was a neighbor of ours who used to remove all the warts in the neighborhood. I never heard of his failing, and I know of many successful removals in our own family. He used a piece of thread. He would tie it around the wart—if he could—with great solemnity, rub it three times, and very carefully put the piece of thread in a paper in his pocketbook. This made a very great impression on us, I remember. It seemed next to a church service, having your wart taken off."

Dr. Bonjean, of Lausanne, in a letter to the *Revue de l'Hypnotisme*, dated March 3, 1896, tells an interesting story of the same sort. An old lady, a relative of his, had long had the reputation of being able to remove warts, and he had himself been cured by her of a very bad one. Her method was to bandage the eyes of the patient and instruct him not to touch the wart or disturb the bandage while she was operating. Her daughter then entered and touched the wart with an object (described by Dr. Bonjean) which could not have had any curative power. The warts disappeared in from one to three weeks. When the old lady died, Dr. Bonjean learned her secret. He saw clearly that her success must be due to suggestion, and he undertook to cure warts without the use of the object upon which she relied, but imitating her methods in other respects. He never hypnotizes the patient, and says he thinks it is only important to impress him deeply with the notion that the warts will go away.

Among the most extraordinary and best authenticated cases of suggested modification of the metabolic processes are those in which burns have been so produced. The first of these was, I believe, produced by M. Focachon, an apothecary of Charmes, in France, on a patient named Elisa F—— He succeeded in doing it several times, and the details can be found in Prof. Beaunis's *Le Somnambulisme provoqué*, pages 72–84. I will describe one or two. On the 12th of May, 1885, at 11 A. M., she was hypnotized, and eight postage stamps were placed on her left shoulder, with the suggestion that a blister was being applied. She was then watched and kept asleep. At 8.15 A. M. next day, she was examined in the presence of MM. Bernheim, Liégeois, Liébeault, Beaunis, and others, and the bandages were removed. All were satisfied that they had not been disturbed. "Within an area of about four by five centimetres the epidermis was found thickened and deadened, of a yellowish color, but it was not raised and had not formed blisters. It was thickened, a little wrinkled, and in a word presented the appearance of the period which immediately precedes true blistering, with the formation of fluid. This region was surrounded by a zone of intense redness, with swelling about half a centimetre in extent." A year later M. Focachon succeeded in neutralizing the effect of a Spanish fly blister on the same patient.* One piece was put on the left forearm and the other on the corresponding region of the other arm. She was hypnotized and told that the one on the left arm would not burn her. She was then watched nine hours and a half and examined. The left arm was almost absolutely unaffected; on the right a blister was forming. The bandages were replaced for forty-five minutes and then examined again. On the right arm was a blister from which a serous fluid was got; the left was intact.

Another such case was reported by Dr. J. Rybalkin, of the Hôpital Marie in St. Petersburg.† The patient, a house painter, sixteen years of age, was hypnotized at 8.30 A. M., and was told he would burn himself on the arm by touching a stove—in which, by the way, there was no fire. He uttered a cry of pain when he touched it, and within a few minutes a red, painful mark appeared on the arm. The physicians then watched this develop into a complete burn. By 10 A. M. next day blisters had developed, these formed a scab, and the wound healed as an ordinary burn would have done.

With such extensive control of the metabolic processes of the skin experimentally demonstrated, it is not surprising to meet with remarkable cures of skin diseases. Thus Dr. Hamilton Os-

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* Liégeois, De la Suggestion, § 278.

† Cf. Revue de l'Hypnotisme, iv, 361, and Myers, *op. cit.*, 338.

good, of Boston,* reports four cases of eczema and one of dermatitis cured or improved by suggestion. One, for example, was that of a boy of eleven, who had suffered from eczema since he was eighteen months old; his body was nearly covered by the eruption and consequent scabs, and the itching was intolerable. He had been treated by many dermatologists without the least success. Dr. Osgood hypnotized him and told him the itching would cease and the skin would become sound. The itching was immediately relieved, and the eruption was nearly gone in a fortnight and quite gone in a month.

The most extraordinary case of the kind, however, that I have yet seen comes from Moscow, and is vouched for by Prof. Kozhevnikoff, the most eminent neurologist of Russia. The account which I transcribe is from the British Medical Journal, November 16, 1895.†

"A 'miraculous' cure has recently occurred in Moscow, where it has caused considerable excitement. It is perhaps a more than usually interesting instance, and therefore deserving of the permanent record given to it by Prof. Kozhevnikoff, who gave the details of the case at the last meeting of the Society of Neuro-Pathologists in Moscow. The professor had not had the patient under his treatment, but had seen him more than once both before and after the 'cure.' The patient, N—— D——, was a lecturer in the Moscow University. He had suffered from a severe form of *sycosis menti* since June, 1894, for which he underwent treatment at the hands of various specialists—among others, of Profs. Kaposi, of Vienna; Schwimmer, of Buda-Pesth; Lassar, of Berlin; Pospiélof, of Moscow; and Stukovenkof, of Kief. In April last he returned to Moscow. His chin was then covered with a freely suppurating eruption. He now sought the advice of a 'wise woman,' an attendant at the baths, who was in the habit of giving herbs and 'simples' to her clients. In this case no such remedy was employed. N—— D—— was told to meet the woman next morning at five o'clock in the Temple of the Saviour, the colossal church on the Moskva River, which has been building all the century and is yet incomplete, in memory of the famous events of 1812. He came as told, and while he remained a passive onlooker, the woman prayed for three or four minutes; the same thing was repeated that evening and again the following morning. But in the meantime the eruption of N—— D——'s face had begun to improve; the discharge ceased, the swelling subsided, and in twenty-four hours scarcely a sign of disease was left. Such are the facts as given by the patient himself, and confirmed by Prof. Kozhevni-

* Revue de l'Hypnotisme, ix, 300.

† See a more complete account in the Revue de l'Hypnotisme, January, 1896.

koff. The professor, however, adds some important points bearing upon the case: The patient is of neurotic temperament; his sister is highly hysterical; he had frequently had boils on both arms with a marked tendency to symmetry in position; and the *sycosis* itself showed some signs of being, if not of nervous origin, at least under nervous influence. The impressive surroundings under which the 'cure' was wrought, and the mysterious cabalistic prayer—which the woman refused to divulge, lest it should begin to act with the person to whom she told it and cease to act with herself—are also factors to be remembered in connection with the neurotic and impressionable character of the patient."

I might extend this catalogue almost indefinitely, but my space is limited. What shall we say of these facts? It is evident that they can not be explained by our present psycho-physiological theories, and many other attempts at explanation have been offered. The Roman Catholic ascribes them to the supernatural intervention of the Virgin or saints; the evangelical Christian sees in them the power of God, and an attempt has been made in recent years by the "faith healers" to make them an essential part of an evangelical creed in which "faith" is the divinely ordained instrument, not merely for the purification of the soul from sin, but for the deliverance of the body from disease as well. The self-styled "Christian scientists" and "metaphysical healers" approach the question from a pseudo-idealistic point of view. Mind, say they, is the only reality; things are nothing but very stable thoughts; the body exists only because the soul thinks it; disease is therefore merely a pernicious fixed idea: abolish the idea, and the disease is *ipso facto* abolished.

It is impossible for any one who has been trained in the study of natural phenomena to revert to such crude theories as these. The "scientific" man, to whom nothing is intelligible unless it is capable of interpretation in the mechanical conceptions of our latter-day atomism, usually finds it simpler to deny all facts which he cannot at once bring under those conceptions. He forgets that experience is the only test of truth, that our scientific conceptions are merely the tools which the human mind has devised in order to grapple with the infinite manifold of experience. They are good tools. They are as much better than the animistic conceptions of primitive man as our modern machinery is better than his axes and chisels of stone; yet our mental as well as our material tools can be improved. There are, I believe, engineering feats which our present appliances can not accomplish, and there are also, I believe, phenomena of Nature which our present conceptions are insufficient to explain. Yet I would not pronounce the former impossible or the latter essentially unintelligible.

CAUSES, STAGES, AND TIME OF THE ICE AGE.

By WARREN UPHAM.

IF we could see the entire earth at once, by some grand extension of our range of vision, as we might walk around a geographic globe a hundred feet in diameter, and examine it fully, with comparison of all portions of its area, probably no other features of the great terrestrial panorama would be so impressive as the wonderful diversity of climatic conditions. At the same time with perpetual summer on the equator and throughout nearly all of the intertropical zone, a wintry covering of snow and ice would be seen on all lands in high latitudes about one or the other pole. While every bounty of luxuriant plant and animal life is present to attract the traveler and furnish him sustenance in the central zone, the rigorous climate which is gradually encountered in approaching the poles, and the general decrease and limitation of both flora and funa, have opposed insuperable obstacles to the most eager and courageous explorers. About four hundred and fifty miles at the north, and about eight hundred and fifty miles at the south, lie beyond the farthest limits of exploration; and more than double these distances must be crossed, respectively, if one would pass, according to Nansen's hope and plan, from one side to the other of the hitherto untraversed circumpolar areas.

During the Ice age, or Glacial period of geology, very extensive and thick sheets of land ice, like those now enveloping the Antarctic continent and the interior of Greenland, overspread the northern half of North America (excepting the greater part of Alaska) and northern Europe, with nearly the whole of the British Isles. The southern boundary of the North American ice sheet crossed Nantucket and Martha's Vineyard, Block Island, Long Island, and Staten Island. On the mainland it extended through northern New Jersey and northeastern and northwestern Pennsylvania, being indented by a great angle, whose apex was at Salamanca in southwestern New York. Thence it reached southwest and west across southern Ohio, Indiana, and Illinois, and through central Missouri, into northeastern Kansas; and beyond, it curved far northward, crossing eastern Nebraska and South and North Dakota. From near Bismarck it again trended westward through Montana, Idaho, and Washington, to the Pacific Ocean not far south of Puget Sound. North of this line an area of about four million square miles, stretching to the Arctic archipelago, was covered with ice hundreds and thousands of feet deep.

The comparatively small present ice sheet of Greenland covers

five hundred and seventy-five thousand square miles,* and rises with average slopes of one hundred feet or more per mile to a central height, along its axial portion, of eight to ten thousand feet, or almost two miles measured vertically, above the sea level. The ancient ice sheets had a similar altitude and thickness. From the directions of outflow of the North American ice fields, as shown by the transportation of the glacial drift, and from the observed upper limits of glaciation on high mountains, Prof. James D. Dana estimated the thickness of the ice formerly accumulated above the Laurentide highlands, between the St. Lawrence River and Hudson Bay, to be fully two miles. It probably varied in thickness from one to two miles across Labrador, the Laurentide highlands, James Bay, Lake Winnipeg, Reindeer and Athabasca lakes, to the Rocky Mountains, in the region of the Peace River, where their summits, lower than southward, were probably buried beneath the ice expanse. In British Columbia, according to Dr. George M. Dawson's observations of glacial striæ and drift on mountains, the ice sheet exceeded a mile in depth.

In all directions from its thick central areas the vast continental glacier flowed outward, carrying its drift from Hudson Strait, Labrador, and Newfoundland easterly beyond the present coast line; from the provinces of Quebec and Ontario southeasterly across New England, and southerly and southwesterly across the basins of the Laurentian lakes; from Manitoba and the Saskatchewan region southerly into Minnesota, Iowa, the Dakotas, and Montana; from British Columbia into Idaho and Washington on the south, into the edge of the Pacific Ocean on the west, and down the Yukon Valley on the north; and from the great northern Barren Grounds northerly down the Mackenzie and across the islands of the Arctic Sea.

Northern Europe and the present basins of the Irish, North, Baltic, and White Seas were covered by an ice sheet which attained an extent of two million square miles, being half as large as that of North America; and its maximum depth above Sweden and the beds of the Baltic Sea and Gulf of Bothnia was one mile, or more probably two miles. The high, much eroded, and channeled Scandinavian plateau even now has numerous local ice fields, varying in size up to five hundred square miles, which are doubtless remnants of a continuous glaciation through all the centuries since the vast European ice field of the Glacial period

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* Measured on a map drafted by the author for Greenland Icefields, by Prof. G. Frederick Wright and Warren Upham (D. Appleton & Co., 1896). From my chapters in this book some later paragraphs of the present paper are derived, with condensation and rearrangement.

flowed outward on all sides from this great plateau. Bowlders from its rock formations were then borne by the slow glacial currents eastward to the head waters of the Volga, southward to the Dnieper and the Rhine, and southwestward to the northeastern shore of England, where the confluent current of the ice flowing away from the Scottish Highlands warded off the Scandinavian ice after its passage over the bed of the shallow North Sea. The European ice sheet extended south only to the latitude of 50°, while that of our continent reached to 38° in southern Illinois; but the difference was similar to the present contrast of the mean annual temperature and isothermal lines of the two continents.

To-day the Greenland ice sheet, the Malaspina ice sheet between Mount St. Elias and the ocean, many glaciers southward along the Cordilleran mountain belt, and the ice fields and glaciers of Norway and the Alps, may be regarded as lingering representatives of the conditions of the Glacial period, which not long ago, geologically speaking, spread a white pall of snow and uninhabitable desolation over large parts of the earth that are now temperate, fruitful, and populous. The returning mild and habitable conditions, with luxuriant plant and animal life, are like the average of long geologic eras which preceded the Ice age, and were of far greater and indeed almost inconceivable duration. The severely cold and snowy Glacial climate of extensive land areas was wholly unlike their mild or even hot climates during the very long Tertiary and Mesozoic eras, of which we find testimony in their fossil floras and faunas. Palms allied to those of the tropics, and sequoias closely related to the big redwood trees of California, grew during Tertiary times in Greenland, Spitzbergen, and the New Siberia Islands. Baron Nordenskjöld, after examining thousands of miles of arctic shore lines, with frequent clearly exposed geologic sections belonging to the periods extending back from the Ice age through the Tertiary or Cenozoic, the Mesozoic, and the Palæozoic eras, affirmed that he nowhere discovered any evidence of glaciation previous to the Pleistocene period, which followed the Tertiary and introduced the Quaternary era.

Latest in the great series of periods made known by the geologic record, the Pleistocene or Glacial period stands alone and unique, unless we must also recognize a general prevalence of glacial conditions at or near the end of the Palæozoic era. Bowlder-bearing deposits which can be explained only as glacial drift, and striation of the underlying rock which testifies unmistakably of the action of great glaciers or sheets of land ice, are found in the Carboniferous or the Permian series, closing the Palæozoic system, in Britain, France, and Germany, Natal, India, and southeastern Australia. In Natal the striated glacier floor is in latitude

30° south, and in India only 20° north, of the equator. Such evidences of late Palæozoic glaciation are also very clearly exhibited on the Varanger Fiord, in the extreme northern part of Norway, beyond the Arctic Circle. During all the earth's history before the Ice age of Pleistocene time, no other such distinct indications of general or interrupted and alternating glaciation have been found. Geologic exploration reveals only these two glacial periods, and they are separated in time by the vast Mesozoic and Tertiary eras, together estimated by Dana and others to comprise some ten to fifteen or twenty million years.

It is especially suggestive, in our inquiry concerning the causes of the Ice age, that both the Palæozoic and the Quaternary glacial periods were characterized by very unusual and exceptional oscillations in the height of continental areas and by the formation or renewed uplifting of great mountain ranges. Epochs in which certain mountain belts came into existence, or, after being partly or chiefly worn away, were restored by great uplifts, have alternated with far longer periods and eras of comparative repose. Between the epochs of mountain-building, the slow wearing and gnawing of rain, frost, and chemical decay have striven to carry away the mountains to the plains and the sea. At two times of the birth or rejuvenation of the grandest mountain chains of the world, with the most remarkable upward and downward movements of continents, the accumulation of glaciers and ice sheets has been closely associated.

Each of these periods of mountain formation, continental uplifts, and widespread glaciation was geologically short; but they were separated by a lapse of time so long that it can be adequately imagined only through the aid of a mathematical or geometric illustration on an almost infinitely reduced scale. Let the duration of a lifetime of seventy years be represented by a span, or nine inches. A century on this scale will be denoted by a foot, a thousand years by ten feet, and a million years by about two miles. The whole duration of the earth's existence since the beginning of life upon its surface, if between fifty and a hundred million years, as estimated by Dana, Walcott, and others, would then be represented by a distance of about one hundred, one hundred and fifty, or two hundred miles. In accordance with the probable ratios of the several great eras of geology, which are determined through comparisons of their thicknesses of sedimentary rocks and their progress in evolutionary changes of faunas and floras, we may place the Palæozoic glacial period at a distance of twenty to forty miles back from the present day, corresponding to some ten to twenty million years. That glacial period may have been no longer than the Ice age recently ended—that is, twenty-five thousand to fifty thousand years, more or less. The

ice ages, therefore, would be marked by a length of some two hundred and fifty to five hundred feet for each on the assumed scale, and they would be separated by an interval approximately two hundred or four hundred times as long, according to the range in the estimates of the length of the intervening Mesozoic and Tertiary eras.

The chief astronomic theories of the causes of glaciation, proposed by Dr. James Croll and General A. W. Drayson, would require the frequent recurrence of glacial epochs during all the vast interval dividing the two times of actual widely extended glaciation of which geology bears record. It seems quite certain, therefore, that we must look rather to unusual conditions of the earth itself than to its astronomic relations as the causes of the Ice age.

Another theory, which supposes changes in the earth's attitude toward the sun, is the suggestion, first made in 1866 by Sir John Evans, that, while the earth's axis probably remained unchanged in its direction, a comparatively thin crust of the earth may have gradually slipped as a whole upon the much larger nucleal mass, so that the locations of the poles upon the crust have been changed, and that the Glacial period may have been due to such a slipping or transfer by which the regions that became ice-covered were brought very near to the poles. The same or a very similar view has been recently advocated by Dr. Fridtjof Nansen, who writes:*

> The easiest method of explaining a Glacial epoch, as well as the occurrence of warmer climates in one latitude or another, is to imagine a slight change in the geographical position of the earth's axis. If, for instance, we could move the north pole down to some point near the west coast of Greenland, between 60° and 65° north latitude, we could, no doubt, produce a Glacial period both in Europe and America.

Very small changes of latitude which had been detected at astronomical observatories in England, Germany, Russia, and the United States, seemed to give some foundation for this theory, which in 1891 was regarded by a few American glacialists as worthy of attention and of special investigation by astronomers, with temporary establishment of new observatories for this purpose on a longitude about 180° from Greenwich or from Washington. During the year 1892, however, the brilliant discoveries by Dr. S. C. Chandler of the periods and amounts of the observed variations of latitude, showing them to be in two cycles respectively of twelve and fourteen months, with no appreciable secular change, forbade reliance on this condition as a cause or even as an element among the causes of the Ice age. This theory is now entirely out of the field. Sir Robert S. Ball, after reviewing Dr.

* The First Crossing of Greenland (1890), vol. ii, p. 454.

Chandler's investigations, estimates that the place of the pole since the Glacial period, and from even earlier geologic times, has been without greater changes of position than would lie inside the area of a block or square inclosed by the intersecting streets of a city.

We come now to the wholly terrestrial or geologic theory of the causes of the Ice age, which in terms varying with increasing knowledge has been successively advocated by Lyell, Dana, Le Conte, Wright, and the present writer. According to this explanation, the accumulation of the ice sheets was due to uplifts of the land as extensive high plateaus receiving snowfall throughout the year. Geology has received from Gilbert, in his monograph on Lake Bonneville for the United States Geological Survey, the terms *epeirogeny* and *epeirogenic* (continent-producing), to designate the broad movements of uplift and subsidence which affect the whole or large portions of continental areas or of the oceanic basins. This view, accounting for glaciation by high altitude, may therefore be very properly named the *epeirogenic theory*. It is adversely criticised by Prof. James Geikie, who calls it "the earth-movement hypothesis."

So early as 1830 Lyell pointed out the intimate dependence of climate upon the distribution of areas of land and water and upon the altitude of the land. In 1855 Dana, reasoning from the prevalence of fiords in all glaciated regions, and showing that these are valleys eroded by streams during a formerly greater elevation of the land previous to glaciation, and from the marine beds of the St. Lawrence Valley and basin of Lake Champlain belonging to the time immediately following the glaciation, announced that the formation of the drift in North America was attended by three great continental movements: the first upward, during which the ice sheet was accumulated on the land; the second downward, when the ice sheet was melted away; and the third, within recent time, a re-elevation, bringing the land to its present height. But with the moderate depth of the fiords and submarine valleys then known, the amount of preglacial elevation which could be thus affirmed was evidently too little to be an adequate cause for the cold and snowy climate producing the ice sheet. The belief that this uplift was three thousand feet or more, giving sufficiently cool climate, as Prof. T. G. Bonney has shown, to cause the ice accumulation, has been only reached within the past ten years through the discovery, by soundings of the United States Coast Survey, that on both the Atlantic and Pacific coasts of the United States submarine valleys evidently eroded in late Tertiary and Quaternary time reached to profound depths, two thousand to three thousand feet below the present sea level.

The continuation of the Hudson River Valley has been traced by detailed hydrographic surveys to the edge of the steep continental slope at a distance of about one hundred and five miles from Sandy Hook. Its outermost twenty-five miles are a submarine fiord three miles wide and from 900 to 2,250 feet in vertical depth measured from the crest of its banks, which with the adjoining flat area decline from three hundred to six hundred feet below the present sea level. The deepest sounding in this fiord is 2,844 feet. An unfinished survey by soundings off the mouth of Delaware Bay finds a similar valley submerged nearly twelve hundred feet, but not yet traced to the margin of the continental plateau. Again, the United States Coast Survey and British Admiralty charts, as Spencer states, record submerged fiord outlets from the Gulf of Maine, the Gulf of St. Lawrence, and Hudson Bay, respectively 2,664 feet, 3,666 feet, and 2,040 feet below sea level. The bed of the old Laurentian River, as the preglacial St. Lawrence is named by Spencer, from the outer boundary of the Fishing Banks to the mouth of the Saguenay, a distance of more than eight hundred miles, is reached by soundings 1,878 to 1,104 feet in depth. Advancing inland, the sublime Saguenay fiord along an extent of about fifty miles ranges from three hundred to eight hundred and forty feet in depth below the sea level, while in some places its bordering cliffs, one to one and a half miles apart, rise abruptly fifteen hundred feet above the water.

On the Pacific coast of the United States Prof. Joseph Le Conte has shown that the islands south of Santa Barbara and Los Angeles, now separated from the mainland and from each other by channels twenty to thirty miles wide and six hundred to one thousand feet deep, were still a part of the mainland during the late Pliocene and early Quaternary periods. In northern California Prof. George Davidson, of the Coast Survey, reports three submarine valleys about twenty-five, twelve, and six miles south of Cape Mendocino, sinking respectively to 2,400, 3,120, and 2,700 feet below the sea level, where they cross the hundred-fathom line of the marginal plateau. If the land there were to rise one thousand feet, these valleys would be fiords, with sides towering high above the water, but still descending beneath it to profound depths. Le Conte has correlated the great epeirogenic uplifts of North America, known by these deeply submerged valleys on both the eastern and western coasts, with the latest time of orogenic disturbance by faulting and upheaval of the Sierra Nevada and Coast Range in California during the closing stage of the Tertiary and the early part of the Quaternary era, culminating in the Glacial period. In the Mississippi basin, from the evidence of river currents much stronger than now, transporting Archæan

pebbles from near the sources of the Mississippi to the shore of the Gulf of Mexico, Prof. E. W. Hilgard thinks that the preglacial uplift, inaugurating the Ice age, was four thousand or five thousand feet more in the central part of the continent than at this river's mouth.

Although the adequacy of the preglacial epeirogenic elevation of this continent to produce its Pleistocene ice sheet was tardily recognized, it was distinctly claimed by Dana in 1870 that the Champlain subsidence of the land beneath its ice load, supposing it to have been previously at a high altitude, must have brought climatic conditions under which the ice would very rapidly disappear. The depression would be like coming from Greenland to southern Canada and New England. In Prof. Dana's words: "Such an extended change of climate over the glacier area was equivalent in effect to a transfer from a cold, icy region to that of a temperate climate and melting sun. The melting would therefore have gone forward over vast surfaces at once, wide in latitude as well as longitude."

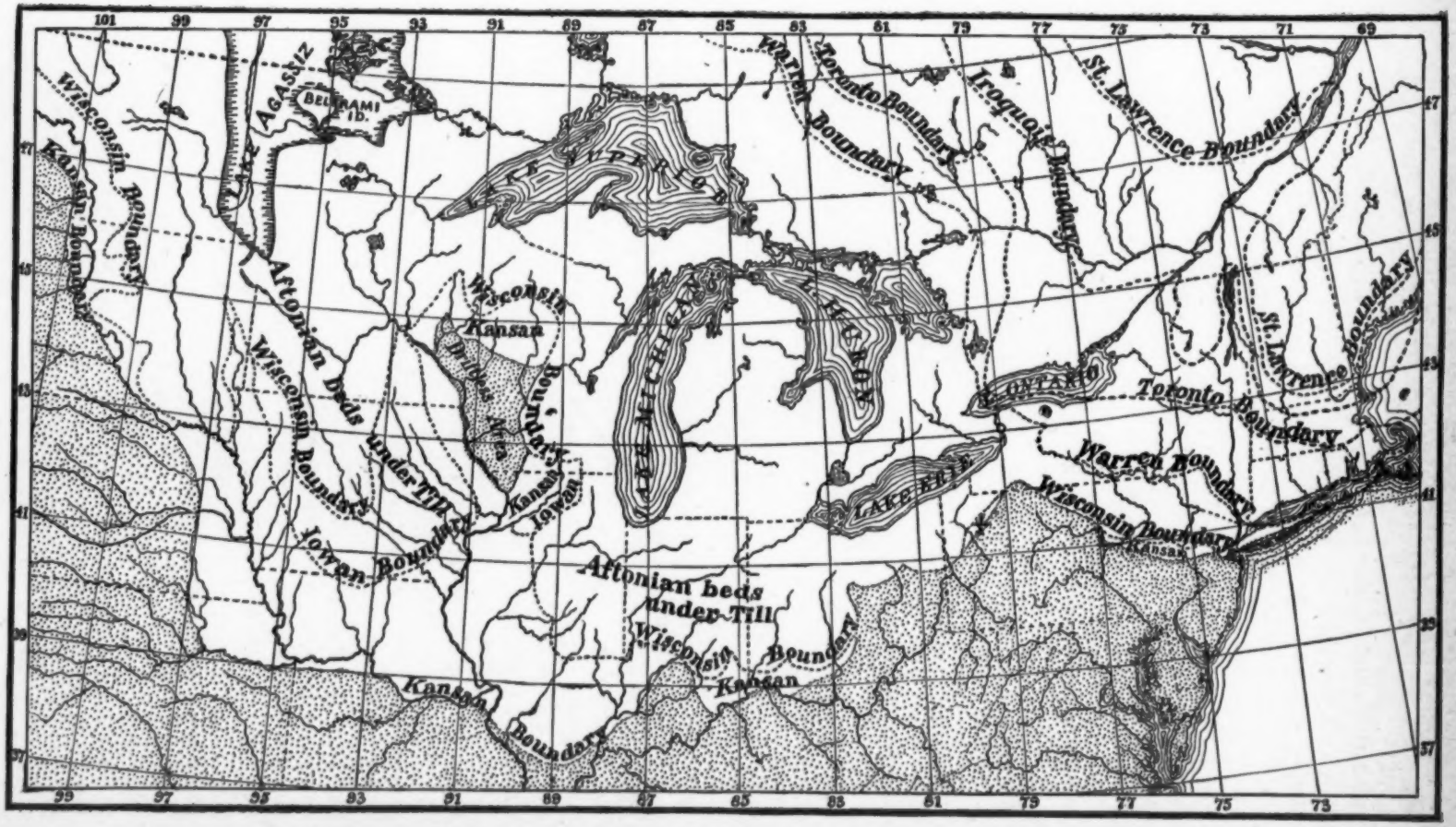
Such explanations as these, accounting for the gradual accumulation and comparatively rapid dissolution of the North American ice sheet, are also found to be applicable to the ice sheets of other regions. The fiords of the northern portions of the British Isles and of Scandinavia show that the drift-bearing northwestern part of Europe stood in preglacial time one thousand to four thousand feet higher than now; while, on the other hand, late glacial marine beds and strand lines of sea erosion testify that when the ice disappeared the land on which it had lain was depressed one hundred to six hundred feet below its present height, or nearly to the same amount as the Champlain depression in North America. Mr. T. F. Jamieson appears to have been the first in Great Britain or Europe to attribute the ice accumulation to altitude of the land, and to hold the view (which I receive from him) that the submergence of glaciated lands, when they were loaded with ice, was caused directly by this load pressing down the earth's crust upon its fused interior, and that the subsequent re-elevation was a hydrostatic uplifting of the crust by underflow of the inner mass when the ice was melted away. Just the same evidences of abundant and deep fiords and of marine beds overlying the glacial drift to heights of several hundred feet above the sea are found in Patagonia, as described by Darwin and Agassiz. On these three continental areas the widely separated chief drift-bearing regions of the earth are found to have experienced in connection with their glaciation in each case three great epeirogenic movements of similar character and sequence—first, a comparatively long-continued uplift, which in its culmination appears to have given a high plateau

climate with abundant snowfall, forming an ice sheet whose duration extended until the land sank somewhat lower than now, leading to amelioration of the climate and the departure of the ice, followed by re-elevation to the present level. The coincidence of these great earth movements with glaciation naturally leads to the conviction that they were the direct and sufficient cause of the ice sheets and of their disappearance; and this conclusion is confirmed by the insufficiency and failure of the other theories which have been advanced to account for the Ice age.

The end of the Tertiary era and the subsequent Glacial period were exceptionally characterized by many great oscillations of continental and insular land areas. Where movements of land elevation took place in high latitudes, either north or south, which received abundant precipitation of moisture, ice sheets were formed; and the weight of these ice sheets seems to have been a chief cause, and often probably the only cause, of the subsidence of these lands and the disappearance of their ice.

The general contemporaneousness of the Glacial period on the opposite sides of the North Atlantic Ocean had been long accepted as probable, but its demonstration and the identification of the corresponding parts of the Ice age, having the same sequence on the two continents, were first made known less than two years ago by the studies of Geikie and Chamberlin in the new third edition of The Great Ice Age, and by their later papers in the Journal of Geology. According to the subdivision recognized by these authors, the time of principal accumulation of marginal moraines is regarded as an epoch distinct from the previous portions of the Ice age; and Chamberlin has named the earlier divisions of this period, when the North American ice sheet reached its culmination, the Kansan and Iowan stages, while the later moraine-forming time is called the Wisconsin stage, from the magnificent development of the moraines in eastern Wisconsin. Between these glacial stages, which appear well recognizable and synchronous in North America and Europe, these authors suppose that there were prolonged interglacial epochs, when the ice sheets were in large part or wholly melted away. To the most important of the warm intervals, separating the Kansan and Iowan stages of ice accumulation and advance, the name Aftonian is given by Chamberlin, from Afton in Iowa, where a thick bed of peat, formed during that time, lies between deposits of glacial drift.

Instead of this view of distinct epochs of glaciation, the Ice age seems to me, while accepting the successive stages here noted, to have been still essentially a single and continuous glacial period, with moderate fluctuations of the ice borders during both the growth and wane of the ice sheet. The marginal moraines I



STAGES OF THE ICE AGE IN THE UNITED STATES AND CANADA. Unglaciated land areas are dotted.

consider to have been formed rapidly while the ice was retreating from its Iowan stage, with no important general readvance dividing the Iowan from the Wisconsin or moraine-forming stage.

Not only are the Kansan and Iowan stages of culmination of the ice sheets closely alike for North America and Europe, but also the land depression of the Champlain epoch in both these widely separated great areas brought marine submergence of coastal tracts, and caused rapid disappearance of the ice sheets, with the formation of their drumlins and marginal moraines. These two continents were included in the portion of the earth's crust which twice experienced far-extended epeirogenic movements, first of high uplift, bringing the cold climate and snow and ice accumulation of the Glacial period, and afterward of depression somewhat lower than now, whereby the vast ice fields were melted away.

The accompanying maps * show the area of the North American and European ice sheets in their maximum extension, and at definite times in their recession, as known by their areas of drift and belts of marginal moraines, and by the beaches of glacial lakes formed between the present watersheds and the northwardly retreating ice border. These maps give the boundaries of the Kansan, Iowan, and Wisconsin formations, adopting these names, according to the law of priority, for both continents, and add for the northeastern United States and Canada the subsequent Warren, Toronto, Iroquois, and St. Lawrence stages in the glacial retreat.

The culmination of the great epeirogenic uplift, which had been in progress through the preceding Lafayette period, raised the glaciated areas, both in North America and Europe, to so high altitudes that they received snow throughout the year, and became deeply ice-enveloped. Submerged valleys and fiords show that this elevation was one thousand to four thousand feet above the present height. The accumulation of the ice sheets, due to snowfall upon their entire areas, was attended by fluctuations of their gradually extending boundaries, giving the Scanian and Norfolkian stages in Europe, and an early glacial recession and readvance in the region of the Moose and Albany Rivers, southwest of James Bay.

During the Kansan stage the ice sheet attained its farthest extent in the Missouri and Mississippi River basins and in northern New Jersey, this being probably at the same time with the Saxonian stage, as later named by Geikie, of maximum glaciation in Europe.

In the Aftonian stage the ice sheet receded from its Kansan

* From Greenland Icefields, chapter xiv, but on an enlarged scale.

STAGES OF THE ICE AGE IN EUROPE. Unglaciated land areas and sea borders of the ice sheet are dotted.

boundary northward about five hundred miles to Barnesville, Minn., in the Red River Valley, and two hundred and fifty miles or more in Illinois, according to Leverett; but probably little between the Scioto River, in Ohio, and the Atlantic coast, the maximum retreat of that portion being twenty-five miles or more in New Jersey. A cool temperate climate and coniferous forests extended up to the retreating ice border in the upper Mississippi region. This great glacial recession was attended with much erosion of the early drift. A corresponding interruption of the severity of the Ice age in Europe is named by Geikie the Helvetian stage or epoch. The greater part of the drift area in Russia was then permanently relinquished by the much diminished ice sheet, which also retreated considerably on all its sides. During this stage the two continents probably retained mainly a large part of their preglacial altitude. The decrease of the ice sheet may have been caused by the astronomic cycle which brought our winters of the northern hemisphere in perihelion between twenty-five thousand and fifteen thousand years ago.

In the Iowan stage renewed ice accumulation covered the Aftonian forest beds, so that the continental glacier extended again into Iowa, to a distance of three hundred and fifty miles or more from its most northern indentation by the Aftonian retreat, and in Illinois it readvanced about one hundred and fifty miles, while its boundary eastward from Ohio probably remained with little change. At the same time, apparently, was the Polandian stage of renewed growth of the European ice sheet, probably advancing its boundaries in some portions hundreds of miles from the Helvetian retreat.

These foregoing stages belong to the early and longer part of the Glacial period, which may be called pre-eminently the Glacial epoch, including the times of mainly very cold and snowy climate which tended to the formation and preservation of the ice sheet. The Iowan stage was terminated by a depression of the ice-burdened area mostly somewhat below its present height, as shown by fossiliferous marine beds overlying the glacial drift up to three hundred feet above the sea in Maine, five hundred and sixty feet at Montreal, three hundred to four hundred feet from south to north in the basin of Lake Champlain, three hundred to five hundred feet southwest of Hudson and James Bays, and similar or less altitudes on the coasts of British Columbia, the British Isles, Germany, Scandinavia, and Spitzbergen. Glacial recession from the Iowan boundaries was rapid under the temperate (and in summers warm or hot) climate belonging to the more southern parts of the drift-bearing areas when reduced from their great preglacial elevation to their present height or lower. The finer portion of the englacial drift, swept down from the

ice fields by the abundant waters of their melting and of rains, was spread on the lower lands and along valleys in front of the departing ice as the loess of the Missouri, the Mississippi, and the Rhine. Marine beds reaching a maximum height of about three hundred and seventy-five feet at Neudeck, in western Prussia, give the name of this Neudeckian stage.

A moderate re-elevation of the land, to approximately its present height, advanced in the northern United States and Canada as a permanent wave from south to north and northeast, keeping nearly equal pace with the continued retreat of the ice along most of its extent. Throughout all the distance from the Atlantic to the Rocky Mountains the mainly retreating but often fluctuating ice margin formed many belts of knolly and hilly drift, called marginal moraines. It is also to be noted that the river basins which slope northward or northeastward were obstructed by the waning ice sheet, so that they were temporarily filled by great glacial lakes, as Lake Agassiz, in the basin of the Red River of the North and of Lake Winnipeg, and a very remarkable series of lakes in the basin of the St. Lawrence, the glacial precursors of the present five great lakes from Superior to Ontario. The very grand development of the marginal moraines in Wisconsin (scarcely, however, surpassing Minnesota) led to the application of the name Wisconsin to this stage of the Ice age and to its drift. In Europe this is named by Geikie the Mecklenburgian stage. Conspicuous moraine accumulations were formed in Sweden, Denmark, Germany, and Finland, on the southern and eastern margins of the great Baltic glacier.

During the maximum extent of the glacial Lake Warren, held on its northeast side by the retreating ice border, one expanse of water, as mapped by Spencer, Lawson, Taylor, Gilbert, and others, appears to have reached from Lake Superior over Lakes Michigan, Huron, and Erie, to the southwestern part of Lake Ontario. Its latest southern beach, traced east by Gilbert to Crittenden, New York, is correlated by Leverett with the Lockport moraine. This and later American stages, all of minor importance and duration in comparison with the preceding, can not probably be shown to be equivalent with Geikie's European divisions belonging to the same time.

In the next ensuing Toronto stage, slight glacial oscillations, with temperate climate nearly as now at Toronto and Scarborough, Ontario, are indicated by interbedded deposits of till and fossiliferous stratified gravel, sand, and clay. Although the waning ice sheet still occupied a vast area on the northeast, and twice readvanced with deposition of much till during the formation of the Scarborough fossiliferous drift series, the climate then, determined by the Champlain low altitude of the land, by the proximity of

the large glacial Lake Algonquin, succeeding the larger Lake Warren, and by the eastward and northeastward surface atmospheric currents and courses of all storms, was not less mild than now. The trees whose wood is found in the interglacial Toronto beds now have their most northern limits in the same region.

Somewhat later came the full expansion of the glacial Lake Iroquois, in the basin of the present Lake Ontario and northward, outflowing at Rome, N. Y., to the Mohawk and Hudson rivers. Gradual re-elevation of the Rome outlet from the Champlain subsidence had lifted the surface of Lake Iroquois in its western part from near the level of the present lake at Toronto to a height there of about two hundred feet, finally holding this height during many years, with the formation of the well-developed Iroquois beach.

The final stage in the departure of the ice sheet which we are able to determine from the history of the Laurentian lakes and St. Lawrence Valley, was when the glacial lake St. Lawrence, outflowing through the Champlain basin to the Hudson, stretched from a strait originally one hundred and fifty feet deep over the Thousand Islands, at the mouth of Lake Ontario, and from the vicinity of Pembroke, on the Ottawa River, easterly to Quebec or beyond. As soon as the ice barrier was melted through, the sea entered these depressed St. Lawrence, Champlain, and Ottawa valleys; and subsequent epeirogenic uplifting has raised them to their present slight altitude above the sea level.

Further stages of the glacier recession are doubtless recognizable by moraines and other evidences, the North American ice sheet becoming at last, as it probably also had been in its beginnings, divided into three parts—one upon Labrador, another northwest of Hudson Bay, as shown by Tyrrell's observations, and a third upon the northern part of British Columbia. From my studies of the glacial lake Agassiz, whose duration was probably only about one thousand years, the whole Champlain epoch of land depression, the departure of the ice sheet because of the warm climate so restored, and most of the re-elevation of the unburdened lands, appear to have required only a few (perhaps four or five) thousand years, ending about five thousand years ago. These late divisions of the Glacial period were far shorter than its Kansan, Aftonian, and Iowan stages; and the ratio of the Glacial and Champlain epochs may have been approximately as ten to one. The term Champlain conveniently designates the short, final part of the Ice age, when the land depression caused rapid though wavering retreat of the ice border, with more vigorous glacial currents on account of the marginal melting and increased steepness of the ice front, favoring the accumulation of many retreatal moraines of knolly and bowldery drift.

COUNTY PARKS.*

By Prof. THOMAS H. MACBRIDE,
of the State University of Iowa.

THE title of this article would seen to require little definition. By county parks are meant simply open grounds available for public use in rural districts as are city parks in towns. There is nothing new in the idea; it is simply an effort to call back into public favor the once familiar public "common." This does not, however, refer simply to public land, such as Government land, to be claimed and plundered by the first comer, nor indeed to land to be used by the public indiscriminately at all, but to land devoted to public enjoyment, purely to the public happiness, a holiday ground for country and city folk alike.

The general features which should characterize such public playground as is here discussed will also quickly suggest themselves to any one who chooses at all to consider the matter. In the first place, the county park should be wooded, that it may afford suitable shade and shelter for those who frequent it; it should be well watered, to meet other patent needs; it should be romantic, in order by its attractiveness to be as far as possible efficient. Above all, it must be under wise control, be at all times suitably warded and kept, that its utility be transmitted from generation to generation. All this is plain enough and will be disputed by nobody. It is the intention here to show that such parks are needed, that they are needed now; that they should have the highest scientific value; and that in the eastern United States, at least, they are everywhere practicable.

The necessity for such parks seems to me to be threefold:

1. As directly affecting public health and happiness.
2. For proper education.
3. To preserve to other times and men something of primeval Nature.

Let us consider these points briefly in the order named.

All of us in one way or another know something of the monotonous grind which makes up the lifelong experience of by far the larger number of our fellow-men—on the farm, in the shop, in the mine, day after day, one unceasing round of toil, into which the idea of pleasure or freshness never enters. How many thousands of our fellow-men, tens of thousands of our women, see nothing but the revolving steps of labor's treadmill, day in, day out, winter and summer, year after year, for the whole span of mortal life! This is especially so in the Western States, where the

* Read in part as a paper before the Iowa Academy of Science, January 2, 1896.

highest ideal is industry; the highest accomplishment, speed. Our rural population is wearing itself out in an effort to outwear "labor-saving machinery." If you do not believe it, take a journey across the country anywhere through Iowa or Illinois and see how the people are actually living. They know no law but labor, their only recreation is their toil. Now it is needless to say how abnormal all this is. We are as a people entrapped in our machines and are by them ground to powder. The effect of it is apparent already in the public health and will be the most startling factor in the tables studied by the man of science in the generations following. Not to paint too darkly the picture, attention may be called to the fact that rural suicides are not uncommon, and that the wives of farmers are a conspicuous element in the population of some of our public institutions. There must be something done to remedy all this, to preserve for our people their physical and mental health; and to this end, as all experience shows, there is nothing so good as direct contact with Nature, the contemplation of her processes, the enjoyment of her peaceful splendor. If in every county, or even in every township, there were public grounds to which our people might resort in numbers during all the summer season a great step would be taken, as it seems to me, for the perpetuation, not to say restoration, of the public health. We are proud to call ourselves the children of "hardy pioneers," but much of the hardiness of those pioneers was due to the fact that they spent much of their time, women, children, and all, out of doors. All the land was a vast park in which that first generation roamed and reveled. They breathed the air of the forest, they drank the water of springs, they ate the fruit of the hillsides, plum thickets were their orchards, and all accounts go to show that hardier, healthier, or happier people never lived. Such conditions can never come again, but we may yet by public grounds for common enjoyment realize somewhat of the old advantage.

Again, such parks as are here discussed are an educational necessity. Our people as a whole suffer almost as much on the æsthetic side of life as on that which is more strictly sanitary. How few of our landowners, for instance, have any idea of groves or lawns as desirable features of their holdings! If in any community a farm occurs on which a few acres are given over to beauty, the fact is a matter of comment for miles in either direction. A county park well kept and cared for would be a perpetual object lesson to the whole community; would show how the rocky knoll or deep ravine on one's own eighty-acre farm might be made attractive, until presently, instead of the angular maple groves with which our æsthetic sense now vainly seeks appeasement, we should have a country rich in groves conform-

able to Nature's rules of landscape gardening if not to Nature's planting.

I am aware that at first the right appreciation of a public park might be meager. The first instinct might be to use the park as a convenient source whence to draw one's winter firewood, or as a free cow-pasture for the adjoining farmer, but such abuse would soon be rectified when the better idea of public ownership came to be understood. This leads also to the remark that such parks in the United States are to-day absolutely needed to teach our people the first lessons in forestry; to advise them how and when to cut timber; the economic value of different kinds of trees and the value of woodland as such; the kind of soil which should be left to trees, and such as may be profitably given over to tillage. We are soon as a people to be sent all to school in matters of forestry and arboriculture; sent to learn the value of the forest in the dear school of experience where we are to be taught the arithmetic of cost.

In the third place, county parks would tend to preserve to those who come after us something of the primitive beauty of this part of the world as such beauty stood revealed in its original flora. I esteem this from the standpoint of science, and indeed from the standpoint of intellectual progress, a matter of extreme importance. Who can estimate the intellectual stimulus the world receives by the effort made to appreciate and understand the varied wealth of Nature's living forms? In this direction who can estimate how great has been our own advantage as occupants of this New World! But such is the aggressive energy of our people, such their ambition to use profitably every foot of virgin soil, that, unless somewhere public reserves be constituted, our so-called civilization will soon have obliterated forever our natural wealth and left us to the investigation of introduced species only, and these but few in number. It is a fact lamented, grievously lamented by all intelligent men, that in all the older portions of the country, species of plants once common, to say nothing of animals, are now extinct. County parks, if organized soon, would enable us to preserve many of these in the localities where originally found.

The objection to all this is that such parks as here broached are impracticable. Such objection can lie in two directions only: (1) the lack of suitable sites, and (2) the lack of suitable control. As to the first, it may be said that in a great number of our counties, especially eastward, such sites exist and have in many cases been long used, and it must be confessed abused, by our people.

Everywhere, even in the prairie States, there are "caves" and "dens" and "fords" and "backbones" and "springs" long popularly named and to some extent enjoyed, places of picnic, ex-

cursion resorts, all of which are in evidence to show at once popular need and popular appreciation. Hundreds of people frequent some of these places every year as they are; what would be the case were it understood that such parklike regions were indeed dedicated to the people for their use and kept and cared for for their enjoyment? Such localities are now generally private property and the public enter by sufferance only. In some places—alas for human nature!—the beauty of the "den" or "palisade" is by its owner ruthlessly defaced as the simplest method of checking an undesirable invasion by the populace. The populace can and should own its own means of entertainment; here and there private benevolence may meet the need, be tolerant of trespass, but it must not be expected.

The second count in the way of objection is a real difficulty whose gravity I do not for a moment attempt to minimize. How to secure, own, and care for several hundred or, for that matter, several thousand acres of land, to be used by all the people, is a problem, especially under our form of government. Were we in the Old World we should find no difficulty. Such localities are owned by the king or his equivalent, and are cared for and guarded with the same assiduity as any other private property. Nevertheless, the people of Europe have free use of the most splendid parks and beautiful woods in the world. The same thing can be true of the United States, hopeless as the task may now seem. In the Eastern States a movement to this end is even now discernible. What Mr. Vanderbilt is doing in North Carolina at Biltmore will doubtless be done presently in all our mountainous and forested States. This is another opportunity for our millionaires, and forest foundations properly established will prove for future generations rich in benediction as any university endowment left in the name of whatsoever State or sect. In Massachusetts five years since a movement was inaugurated for the accomplishment of similar purposes in New England. A board of trustees, by Legislature authorized to act, becomes the legatee of suitable property donated for public use, becomes the curators of such grounds, and the custodians of funds bequeathed for the care of such lands or for their purchase. The result in Massachusetts of such a simple effort has in five years proved most gratifying to the projectors as to every lover of his native land. Thousands of acres have already been rescued from spoliation and subjected to intelligent management such as will eventually result in the attainment of all the beneficent ends for which public parks exist. In most States nothing is done; nothing will be done until somebody or some association of our citizens make a beginning. That the effort will one day be made there is no doubt. Whether it shall be made in time to save that which Nature in this direction

has already committed to our hands is a question. Is not the problem worthy the consideration of all citizens and legislators, and does it not open to us a field where by practical activity we may again show before the world our practical sense and wisdom?

SOCIOLOGY IN ETHICAL EDUCATION.

By BYRON C. MATHEWS.

THE fact that there is great social discontent throughout the entire western world requires no demonstration. The forms in which it manifests itself are numerous. In the various phases of socialism, and in nihilism, it permeates every department of European life. In the rural portions of our country the same spirit of discontent, though in a much milder form, manifests itself in the Farmers' Alliance and in the Populist movement. In our cities and towns it appears in labor organizations and in socialistic societies.

The adjustment of the parts of our social organism is certainly not harmonious. Collisions between classes whose interests are opposed have at times paralyzed domestic commerce, have involved the comforts of the nation, and have reminded thoughtful men and women of conditions preceding revolution. Not infrequently State militia, and even the United States troops, have been called out to protect life and property and to quell riots.

It is important that educators should inquire whether the schools are in any degree responsible for this unfortunate condition of affairs. We are compelled to acknowledge that we think they are, though not in a blameworthy sense, for the forces of no other agency have been guided with purer motives; hence there is no place for condemnation. The relation of the schools to society, however, is so intimate, and their influences are so potent in their formative effects, that it would be folly to claim that they are entirely free from responsibility in this grave matter; since, even if they have not contributed directly and purposely to it, they have not studied to prevent it. They have cultivated, unintentionally of course, those characteristics of the race which have produced it, and have failed to cultivate, except incidentally, those better characteristics which must correct it.

Throughout the whole course of the development of our public schools, their relation to the child as an individual, with personal ends in life to be attained, has always been a prominent feature and a determining factor; while their relation to the child as a member of society has never been sufficiently emphasized. The

effort, therefore, on the part of the schools has uniformly been to enable the child, when grown to manhood, to successfully guard his own interests and secure his personal ends. There has been no general or continued effort to so train and so develop him that he will contribute to the welfare of society. The result has been to center and to fasten his attention upon his personal interests, and to cultivate in him selfishness instead of an altruistic spirit, which is the truly social spirit, and which alone will produce harmony among the classes now in collision. Why has the child been taught to read, to write, to cipher? Primarily because a knowledge of these has seemed to be absolutely essential in securing his so-called rights among his fellows. Only recently has his relation to society been seriously considered. His ethical side is now demanding cultivation more loudly than ever. So far as education is purely intellectual, it only trains him for a fiercer part in the great human struggle for personal ends, and tends to diminish the severity of that struggle in such degree only as purely intellectual culture indirectly contributes to the ethical, through attention to subjects related to the ethical.

Back of all social discontent, back of all forms in which it appears, we find the primary cause of social disorders in the presence of erroneous ideas among men, particularly the presence of erroneous notions concerning the relations which exist among men. There are certain fundamental ideas upon which the social edifice is built—pivotal ideas about which the social world turns. In each of these ten thousand others germinate; and the ten thousand are wrong if the one is wrong. The following are examples of these erroneous, fundamental, pivotal ideas, which have become stock notions of the people: Cæsars and Napoleons are civilizers; royalty is related to the gods; the Creator made some to be served, others to serve; legality is justice; standard belief is more important than standard character; morality divorced from religion is dangerous. Any social structure founded upon such ideas alone is a monstrosity. To-day we stand face to face with the fact that these very ideas, and others like unto them, form a very large part—entirely too large a part—of the foundation of modern society.

All existing governments and all other institutions have been at some time simply abstract ideas in somebody's brain, and afterward have become concrete realities; right ideas giving birth to right institutions, wrong ones to wrong institutions. This same relation of cause and effect which exists between ideas and institutions, exists also between ideas and the character of individuals, and between ideas and the character of the relations which exist among individuals. Just so far as individual character and existing relations among men are right, they are the product of

right ideas; so far as they are wrong, they are the product of wrong ideas.

If, as we think, the presence among men of erroneous ideas is the cause of social disorders, the cure will be their displacement, through educational processes, with such as will produce right character in men and inspire right relations among men. We believe this is entirely possible, and we think that both the agencies and the methods are in sight. Both must be educational. All political and legislative schemes, the single-tax theory, the nationalization of land and industries, all socialistic projects, all cooperative remedies, will prove of little avail, if they aim at curing social disorders by improving the environment only of the man. *The man himself is wrong.* He is the thing which needs correction and improvement; not the world in which he lives, or the form of government under which he lives. The only possible way of correcting him, and through him of permanently curing social disorders, is through the processes of education—education of the child with the potential man in him.

The Church, the press, and the schools are the agencies which, supplemented by other forces, have determined the existing fundamental ideas of society. If these agencies have been able to formulate and fix these, they certainly can modify them, or even displace them by others. The functions of these agencies, however, and the methods employed in the execution of these functions, must be modified, some even revolutionized. Although the Church and the press, the discussion of whose functions and methods the limits of our paper forbid, are powerful agencies whose influence is beyond all computation, or even conjecture—which must be employed in the improvement of social conditions—yet they are not the agency upon which greatest reliance can be placed. This is found in the schools—the great free public-school system. There is greatest hope in this agency for many reasons: particularly because its organization, and no other, is fully adapted to the requirements of the situation; because it deals with the child, which is a moldable and not a crystallized thing; and because the schools are the agency which in large degree determines the character of all other agencies.

Our hope, then, is in the schools; but their function and their methods must be modified, because they are not giving to the world the best they can give. They are not giving what the world most needs—the best possible character, which results very largely from a careful, rational study of our relations to others, from a right understanding of all those relations which are interwoven everywhere among men in all phases and departments of life. Nothing is more important for our children and youth to understand than the nature and character of human relations;

but these are ignored, as if there were no such relations. Here, in our judgment, is the most serious defect of our schools, and not in the lack of proper "correlation" of studies.

Whether the study of human relations is the province of the schools we can not stop to discuss, but pass it with the remark that the schools belong to the people, and the people have the right to do what they please with their own. They can make the function of the schools whatsoever they choose to make it—whatsoever will serve themselves best.

How can this most serious defect be remedied? By introducing instruction in pure human ethics, divorced from religion, which then becomes a study of the relations which exist among men in this real world. One great difficulty in the way of providing instruction in ethics heretofore has been the lack of a clear distinction in the minds of the people between ethics and religion. The Christian world has been in the habit of thinking and of claiming that there can be no valid system of ethics, except that which is based upon the existence of God, and upon the relations which we suppose exist between him and us. This claim has never been substantiated in a manner satisfactory to scientific thought. Religion is a system of beliefs and worship, and points to an after life, for which we all hope; while ethics is a system of principles of conduct for man as a social being in this life, which we are all now living. Ethics deals with realities, with a real life in a real world. Its realm is entirely a realm of actualities; while the realm of religion, defined in a scientific manner, is one of beliefs and hopes. So far as these beliefs and hopes are determining factors in the conduct of man to man, the realm of religion affects the realm of ethics. But apart from this, if by some magic power the realm of beliefs and hopes were annihilated, the realm of ethics would remain absolutely undisturbed. Does ethics, then, find its basis in religion? Does that which is real depend for its existence upon that which we suppose to be real? It may, providing that which we suppose to be real is actually real; but when, as in this case, it is beyond human powers to determine whether it is real or not, it is about as unphilosophical to declare that something which is known to be real depends for its existence upon another something which we suppose to be real, as to declare that the Himalayas hang upon the sky. The only possibility of substantiating the claim that ethics and religion can not be divorced is found in so formulating a definition of one of them as to embrace in it the realm of the other. But such an attempt would be futile in this scientific age of discrimination and definition. Ethics and religion are both right, and have their separate and appropriate missions and fields, which, as we have indicated above, overlap; but their foundations are two distinct things in

reality, and ought to be made so in definition. The sooner this distinction is recognized, the more rapid will be the moral development of the race.

Upon what, then, can a system of ethics be based? *Upon the fact of human relations.* If there were only one human being in the world, there would be no need of an ethical system, because there would be no other man with whom he could have any relations. Neither would there be any need of it if the inhabitants were few, and were so scattered over the earth that no one of them, in securing for himself the necessaries of life, would ever come in contact with any of all the others. But, just so soon as any one place on the earth becomes the common abode of two, so soon relations are established between them, and there is need of principles of conduct governing each in his acts which in any way affect the other. An ethical system to control the actions of these two men alone would be very simple. But when, from increase of population, or for motives of common interest, individuals unite and form a tribe, there comes to be tribal ethics. When two tribes come in contact, intertribal relations are formed; and when tribes grow into nations, national and international ethics arise; and as the life of the individual becomes more complex within itself, and more involved in its relations to other members of the same tribe or nation, and as the nations increase in size and number, the rules governing this increased complexity must by necessity become more and still more complex, until we have the most possible complex system of ethics governing the most highly developed society. It is here, in this fact of human relations, that we find a basis for human ethics. It is the instruction of our children and youth in these relations for which we plead as a remedy for social disorders. Some recent modifications of school work point toward such instruction; but, in our judgment, none of them are calculated to satisfy the demand of our day. The moral results of the work in the kindergarten, where the little ones are unconsciously instructed in their relations to each other, can not be overestimated. Similar results ought to be produced all along the line of educational work, but these can not be secured through kindergarten methods with children beyond kindergarten age. Other methods must be invented appropriate for different ages.

If the study of human relations is so important, how can our children and youth be instructed in them? We venture to reply that this end can be attained by the introduction, in elementary and as yet undeveloped forms, of the new science of sociology, which, if not scientifically defined as the science of human relations, certainly treats of the whole realm of these relations, and no other science does. There is evidence that "the education of

the future will be sociological; that the supremacy which has been accorded to the physical sciences will be transferred to sociological studies."* The tendency is certainly in this direction. It is seen in the methods employed and in the character of the work done in the kindergarten, in the comparatively fruitless efforts to extract moral lessons from subjects already taught, in the use now being made of the story and myth in literature, in the making of text-books with a view to moral impression, in the provision made for manual training, and in the preference shown by the Committee of Fifteen for "an objective and practical basis of selection of topics for the course of study, rather than the subjective basis so long favored by educational writers."† All this is in response to a demand that our schools must do something more than to cultivate brain power. They must also guide it. All possible means must be utilized in meeting this demand; but, in our judgment, it can be more fully met through sociological studies than through all the means and methods now employed. This line of study can, without doubt, be made the vehicle for effective moral impression.

Apart from the ethical character of this new science, which renders it superior to all other subjects for ethical purposes, it possesses two very important advantages which disarm two classes of objectors to ethical instruction. One class is composed of those who say that we can not teach ethics, because that means religious instruction. This objection falls to the ground through the separation of ethics and religion, which this new science assists in establishing. Since this is so, and since the ethical codes of all parties interested in the schools are substantially the same, and since there is no hope that the state will ever provide for religious instruction, may we not hope that on this ethical ground which sociological studies furnish, a compromise may be effected through which something may be accomplished in the schools of vastly greater importance to humanity than any degree of manual training, or even of purely intellectual development? Those who are opposed to religious instruction would not be losing their case, since ethics is not religion. All who desire religious instruction would, from their point of view, be gaining their object in part, since they include ethics in religion. To no party would this be a sacrifice of principle.

The second class of objectors declare that direct moral instruction would be abortive; that all moral impression must be made indirectly. This is an assumption to which the facts of experience are opposed. However, without stopping to argue

* Prof. Fulcomer, Lecturer in Chicago University.

† Report of Committee of Fifteen.

this point, we present to this class of objectors this same subject, which can be so handled, if it is desired, as to slyly insinuate moral lessons into the boys and girls when they are off guard—side-flank them. With this notion we have no sympathy. Moral training must be known as moral training. An importance of its own must be attached to it by placing it on the same level with, or even above, every other branch. On the other hand, sociological studies can be so employed as to openly, frankly, teach matters of right and wrong, and stamp such an importance upon the right as to make a profound impression.

The ways and means of teaching this new science must be discovered by trial. Whatever is said here in reference to this point is purely suggestive and tentative. The present undeveloped condition of the science requires that first effort shall be made with the most mature pupils, hence in the high schools. Later, without doubt, what may be called elementary sociology will be developed and adapted to the other grades. Child sociology is already taught in a practical way in the kindergartens.

The primary aim ought not to be to acquaint high-school pupils with the theory of sociology, desirable as that may be, but to make them as familiar as possible with the multifarious relations of life, before they enter upon them as individuals independent of parental protection and guidance. Perhaps I can indicate most clearly the line of work, as it lies in my own mind at present, by venturing a few thoughts upon the character of a text-book suitable for this work. I would devote the introductory chapters to the establishment upon a philosophic basis of some universally accepted ethical principles, with which human actions are to be compared and adjudged as right or wrong. The best, the simplest, the most easily understood, and the most generally accepted is, "Do unto others as you would have them do unto you." In our judgment this is entirely sufficient. Nothing better is known, and I would make a text-book sing the spirit of this beautiful principle of social life on every page. It is the condensed epitome of all the ethical teachings of the great Master of ethics as they are recorded in the New Testament; hence, acceptable to all Christian peoples and institutions. This can be based upon a philosophic induction from social data. This, perhaps, would clothe it with an authority which, because it has been heard so often and so universally ignored, it unfortunately does not now possess.

A similar induction might be made to result in some other general principle, if that is desired, like that of Bentham, which, without philosophic verbiage, is that that is right for this world which aims at the greatest degree of happiness to the largest number of persons. These and other like generally accepted

principles are sufficient guides for all in all ordinary situations in life. After these have been established they must be so stamped upon, so burned into the mental fiber of every pupil, that he must by necessity carry them through life; that he can not by any possible line of conduct cause them to fade out, or by logical process silence their voice. This result I would make the aim of the remainder of the book, which should embrace civics in all its branches, business and industrial relations in all their ramifications, natural rights and duties of the individual, the objects, rights, and obligations of society and governments, and all kindred subjects.

Civics embraces duties to country and whatever contributes to best citizenship. Under this topic I would direct attention to political abuses of all sorts, and impress the importance of living by the same moral code in politics as in religion. I would discuss whatsoever would bring plainly to view the individual's ethical duties and obligations to country and government. In the treatment of business relations I would go into the details of the various branches. It seems entirely practicable for a man familiar with business life and methods to conduct students equipped with their code of universally accepted moral principles, according to which human actions are to be classified as right or wrong, into and through the ten thousand ramifications of all kinds of business, behind the counter, into the bank, into the boards of trade, into the business and professional office, into the exchanges, into the council chambers of great corporations, into every corner of the business world, and study the relations which exist among all who are occupied there, as well as between these branches and the great world outside. Here the like relations of the industrial world should be considered, the relations between those who possess capital and those who labor, between those who employ and those who are employed, the rights of each and the duties of each to the other.

In treating of the natural rights and duties of the individual I would attempt to impress the ethical relations between individuals which arise from the fact of birth. All are in the world through no merit or fault of their own, hence no credit or blame attaches to the fact of being here in any case. No man brought anything with him which every other man did not bring; hence all by Nature are endowed with equal rights and entitled to equal opportunities. This opens up an immense field of thought in the direction of modifying the existing conditions of unequal rights and unequal opportunities, which all students of social questions recognize with serious misgivings.

Closely allied with this subject are the objects of social organization, the relations which exist between society and the indi-

vidual, the rights of each, and the duties of each to the other. Society is a necessity. Being a necessity, it ought to be so organized as to continue and perform its functions with the least possible friction, and the greatest possible comfort and happiness to all who compose it. Hence the immeasurable importance of investigating, and of establishing in the minds of the rising generations an ethical adjustment of the parts of the social organism.

MASSAGE IN SPRAINS, BRUISES, AND DISLOCATIONS.

By DOUGLAS GRAHAM, M. D.

IN the Life and Letters of Mr. George P. Marsh, Volume I, page 219, is the following account of the brilliant success of the treatment of two sprains by a wild Arab: "There seemed, however, small chance that the proposed journey to Sinai, Petra, Jerusalem, etc., could be carried out. The season was already far advanced for desert travel; Mr. Marsh had seriously sprained his ankle at Karnac while carrying his wife through the great temple, and could not now walk without the assistance of two persons; and Miss Paine had been suffering from a somewhat similar sprain even before leaving Constantinople, and had profited little by the surgical skill of the Franks at that place or in Egypt. The dragoman, though it was clearly for his interest that the journey should be made, admitted the impossibility of it under these circumstances, and gravely proposed that the two sprains should be cured at once by an Arab doctor of his own acquaintance. He entreated so earnestly and with such apparent confidence in his miracle-worker that a consultation was held with some of the oldest and most intelligent of the Frankish residents at Cairo, and, though no one would exactly take the responsibility of advising it, every one said that the evidence of these immediate cures was such that he should certainly try the experiment in his own case. Some, indeed, had tried it with entire success, and no one thought any harm could come of it.

"These considerations, added to an intense desire to see more of the mysterious East, decided the lame patients to call in the '*radoubeur.*' So, the second morning after their installment in their hotel, Achmet presented himself, bringing with him the most extraordinary creature that can be well imagined. He was scarce five feet in height, and was clad in a single garment of blue cotton fastened about the waist with a leather belt. His old, withered face was lighted up by one eye only, and that seemed but half open, while nothing about his person would have led one to believe that the waters of the broad Nile were within reach. There

was an unmistakable look of mortification on the part of those who had consented to summon this Æsculapius, but there was no help for it now. At this moment a visitor was announced to Mr. Marsh, and the lady therefore was the first to prove the wild man's skill. He examined the injured foot, placed it in warm water, dipped his own fingers in olive oil, and rubbed and pressed the foot very gently for about twenty minutes. He then carefully dried it and bade his patient walk. She hesitated, having suffered so much and so long from every effort of that kind; but an imperative '*Imsheh, imsheh,*' decided her. She placed her foot firmly on the floor and took a step, another and another, and still no pain. In a few minutes she was in the street, and, after strolling some hours among the bazaars of the city, returned without the least feeling of discomfort. The cure was perfect and permanent.

"In the meantime Mr. Marsh had passed through a more severe ordeal at the hands of the magician. His foot and ankle, which were both badly swollen and discolored, were very sensitive to the manipulation, and especially to the energetic pulling which in this case was a part of the treatment, and at the end of three quarters of an hour he was well-nigh exhausted by the pain. But then, on looking at his foot, he was surprised to find that the swelling had disappeared, the color was almost entirely natural, and the shoe and stocking, which had been laid aside for almost two weeks, were put on with perfect ease. He was then directed to walk, which to his amazement he found he could do without the least pain; and the only unpleasant sensation he experienced afterward was a slight stiffness for the first day or two, which, however, did not in the least interfere with walking. After this, preparations for forty days' wandering in the desert were made as rapidly as possible."

Making allowance for the enchantment that distance always lends, there is little doubt that these two injuries were much benefited by the manipulations of the wild Arab. But it is very evident that he hurt his second patient much more than there was any need of. It would, indeed, be strange if the teachings of science did not enable us to improve on the methods of blind instinct. And though science often follows art with limping strides, yet here we can say that science has caught up with art and together they work for the rapid amelioration of disabled joints. No sane person would think of having massage applied immediately to the seat of a sprain, but many imagine that this is what the *masseur* will do, and hence deprive themselves of the early benefit that might be got from this method of treatment, which quickly relieves the pain, the heat, and the swelling, removes the pressure from terminal nerve filaments, and prevents the parts from stick-

ing together. No two *masseurs* are alike by nature nor in skill, tact, and education, and the one who knows his anatomy and physiology well, when called to a recent acute sprain, will not begin at once to *masser* the injured joint, but at a distance above it on the healthy tissues by gentle stroking or *effleurage* toward the heart, gradually proceeding nearer and nearer to the painful place. This has a soothing effect and pushes the flow along in the veins and lymphatics, making more space in them for the returning currents coming from beyond and carrying away the fluids that have leaked out of the vessels. The same should be done on the part of the limb beyond the joint, for the circulation is hindered both in going out and coming in by reason of the swelling.

Next, the *masseur* who knows his business will begin again at a safe distance above the injured joint, and use deep rubbing, kneading, or massage properly so called, one hand contracting as the other relaxes, alternately making circular grasps, with the greatest pressure upward, and this should be done on the parts above and below the seat of sprain. By this procedure the effects of the previous stroking or *effleurage* are much enhanced an analgesic or agreeably benumbing effect is produced upon the nerves which extend to the painful place, and the retarded circulation is pushed along more vigorously, making room in the vessels for the swelling, the effusion, the dammed embargo caused by the landslide of blood and lymph that is inundating the surrounding territory with exudates farther up the stream to float off, and preparing the way for the next step in treatment. At the end of fifteen or twenty minutes of this manner of working, gentle, firm pressure can be made immediately over the swollen and but recently very tender parts, which in a few seconds can have circular motion, with the greatest push upward added to it; and this, if sufficient tact be used, will in all probability not hurt but be positively agreeable. By this the swelling is spread over greater space, pressed out of the tissues as water is out of a sponge, and brought into more points of contact with the veins and lymphatics by which they are absorbed and carried off; the same pressure that causes the dislodgment of stagnating fluids also aiding absorption by pressing them into the small vessels. Then a snug, well-fitting bandage should be applied, which may exhibit the bungling of a tyro or the skill acquired by twenty years' practice. Under this plan of treatment, used twice a day, the comfort produced and the speed of recovery would scarcely be believed unless experienced by one who had had a similar injury treated in the regular orthodox way, with absolute rest and immobility, by means of fixed dressings.

Some years ago I published the results of massage in more than seven hundred cases of sprains, joint contusions, and distor-

tions of all degrees of severity, treated by many different observers, most of whom were French, German, and Scandinavian army surgeons, in order to confirm the experience obtained in some of my own cases. The invariable result of each and all was that such injuries thus treated got well in one third of the time that similar cases did under the usual method of absolute rest and fixation, and with less tendency to subsequent weakness, pain, and stiffness. Experience teaches that the sooner after a sprain massage is begun, the quicker is the recovery. In Germany the military authorities now require a semiannual report from their surgeons upon the results of massage in injuries of joints; and the statistics of Gasener, Starke, Körner, and others clearly show the rapid results of this method, and the economy of time to the soldier. I fear it will be a long time before many of the physicians and surgeons in the United States will condescend to try their hands at massage; indeed, most physicians adopt, prescribe, or tolerate massage in the same way that Constantine the Great embraced Christianity—more from policy than conviction.

The orthodox treatment of absolute immobility alone in these cases has little else to support it than the dogmatism of centuries, from which it is almost impossible for a surgeon to free himself, unless he has been the unfortunate victim of a sprain, and had it treated with massage. Supposing a prize of ten thousand dollars were offered for the quickest way to make a well joint stiff, what more effectual means could be resorted to than first to give it a wrench or sprain, and then do it up in a fixed dressing, so that the resulting inflammation would have an opportunity of producing adhesion of the parts? And this is the prevailing treatment of sprains. The same plan of treatment is employed for the purpose of closing up holes in other parts of the body—namely, that of exciting adhesive inflammation; and, unfortunately, it sometimes closes the cavity of a joint also.

It would seem as if we had sufficient proof of the beneficial effects of massage in injuries and affections of joints in human beings, without intentionally inflicting similar injuries on animals in order to treat them by massage, and study the effects of this upon them. However, much interesting and confirmatory evidence has resulted from such experiments, and the effects produced are no longer left in the realm of theory, but brought into the sunny light of science and ocular demonstration. The mind of man may be prepossessed in favor of massage, and this would help recovery; of animals it can not be, unless they had had massage before for a similar hurt. Animals that have been treated by massage can be killed and the effects studied and compared with similar injuries in other joints of the same animal that have not had massage. Von Mosengeil, Professor of Surgery

at Bonn, injected corresponding joints of rabbits with Indian ink. With each rabbit he *masséed* one of the joints at regular intervals, and left the same joint in the other limb untouched. The swelling and stiffness caused by the injection rapidly disappeared under massage, and on examination of the *masséed* joint after the animal was killed it was found empty of its colored contents. Even when the examination was made shortly after the injection and the use of massage, there was scarcely any ink found in the joint; part of it was found upon the synovial membrane, and upon microscopical examination it was seen that the greatest part of it had been forced into and penetrated through the synovial membrane. The darkened lymphatics could even be seen with the unaided eye extending from the injected joint to the lymphatic glands in the groin or axilla, and these latter were also black from the absorption of the ink. Upon examination of the joint cavities that had not been *masséed*, the ink was found in the joint, mixed with the synovia, forming a smeary mass, and it had not even penetrated the tissue of the synovial membrane. The same results were uniformly obtained in all the experiments, showing that absorption takes place from joint cavities by means of lymph spaces and small openings communicating with lymphatic vessels, and through these with lymphatic glands.

But by far the most interesting experiments yet performed to elucidate the effects of massage on joints, muscles, and nerves are those described at length in the *Archives générales de Médecine* for 1891 and 1892. Having obtained excellent results from massage in bruises of joints and muscles, in sprains and dislocations, and also in fractures, some of which were *masséed* from the commencement of the injury when there was no displacement, and others where there was displacement, after a fixed dressing had been applied as short a time as possible to keep the parts in place, M. Castex sought further opportunities to study more exactly the results of these injuries by intentionally producing them in corresponding places in two limbs of dogs, *masséing* the seat of one of these injuries and letting the other alone, and after five or six months killing the animals and examining the tissues that had been hurt under the microscope. He always chose the more injured limb for treatment and the other had no massage, but was left to the natural evolutions of the injuries. The effects, immediate, consecutive, and remote, were carefully noted by experts in laboratory work, who were not told which leg had been *masséed*. The experiments were done in the laboratory of Prof. Richet. The massage was done either immediately or very soon after the injuries—even in the case of the dislocations, as soon as they were set—and always with marked

relief to the pain, swelling, and stiffness; so much, indeed, that after a few massages of five or ten minutes each of frictions and *pétrissage* once a day, the dog had full use of the leg that had been *masséed*, whereas the leg that had not been *masséed* remained swollen, stiff, and painful for a long time, and in some did not recover at all. It is but fair to state that, no matter how severely some of the dogs were injured, especially the shepherd dogs, they did not seem to mind it at all after it was over, running about as if nothing had happened as soon as they were set at liberty. These were not chosen for massage. The details are amazingly interesting, but space forbids mention of more than one of the experiments, which may be taken as a fair sample.

The two shoulder joints of a large watchdog were dislocated by inward flexion. The head of the humerus of each was plainly visible under the skin, showing a luxation forward and inward—intracoracoid. It was easily reduced, put back in place, by traction. Five minutes of massage was at once given to the right shoulder, which seemed to afford relief, judging from the grateful way in which the animal submitted; and after this a figure-of-8 bandage was applied around both shoulders. He had massage five minutes daily to the right shoulder alone, and for the first three days he walked with difficulty. The right shoulder gradually became less painful to touch, and he stood firmer on this side. On the fourth and subsequent days all sorts of pressure upon the *masséed* shoulder were borne without discomfort; but when the other shoulder was pressed the dog growled and attempted to bite. Six days after the dislocations he supported himself well in the *masséed* limb, but held the other up, as the *non-masséed* shoulder was still swollen and painful. Both shoulders then staid in place, in spite of passive movements that might have dislocated them. On the eighth day the dog walked well with the *masséed* limb, but held the other up, as the latter was still swollen and painful, and there was crepitation in the joint. Thirteen days after the injury the dog took an occasional step with the limb that had not been *masséed*, and two months later it was in about the same condition, while he made free use of the limb that had been *masséed* in walking and running. There was then atrophy (wasting) of the muscles of the left shoulder, evident by the prominence of the bones; none, of the muscles of the right.

Testimony in favor of the early use of massage in dislocations in human beings, being careful not to move nor disturb the joint, is gradually accumulating. Not only M. Castex, but also MM. Fége, Archambaud, and others, have reported more favorable results from its application from the very first day of the injury than when it had not been used. Passive motion, I think, should not be begun until the patients find that they can make a little

voluntary motion. Fifteen or twenty days of this treatment seems to be all that is necessary in mankind; and this is just about the length of time required for the repair of the rent in the capsule. In the meantime, the surrounding tissues are preserved in health and activity by means of the massage.

Soon after the swelling from the injuries to the dogs had subsided the muscles became more or less atrophied in the limb that had not been *masséed*, but not at all in the limb that had been *masséed*. At the end of five or six months the dogs were killed and the tissues examined by the microscope. The muscular tissue of the side that had not been *masséed* presented a diffuse sclerosis or hardening; the connective tissue intervening between the fibers and bundles of fibers was thickened; there were interstitial hæmorrhages, especially in the cellular tissue around the

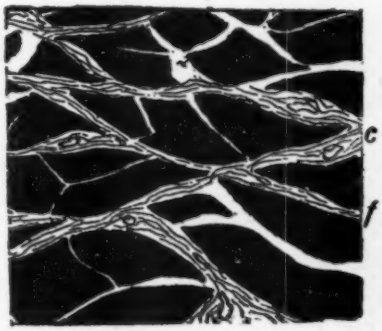


FIG. 1.—BRUISED MUSCLE WITHOUT MASSAGE. *f*, muscular fasciculus; *c*, intermuscular connective tissue.

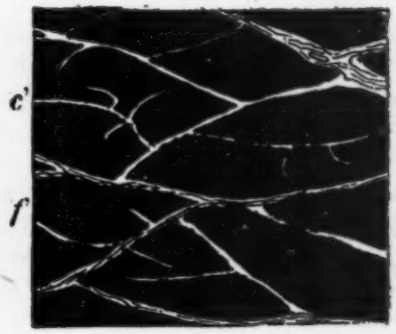


FIG. 2.—BRUISED MUSCLE WITH MASSAGE. *f'*, muscular fasciculus; *c'*, intermuscular connective tissue.

Fig. 2 shows that the natural size of the intermuscular connective tissue has been preserved, while Fig. 1 shows the intermuscular tissue thickened, and the muscular bundles thinner and compressed. (From the *Archives générales de Médecine*, Fevrier, 1892, p. 197.)

muscles; the internal and external coverings of the bundles of muscular fibers (perimysia) were infiltrated with blood, and also the fascia or covering outside of this. The transverse markings of the muscular fibers (striæ) were effaced in many places, while the longitudinal striation or marking, which is not seen normally, was very distinct. The muscular tissue from the corresponding region that had been *masséed* was found to be normal in every particular. M. Castex has left us to surmise the appearance of the sarcolemma or covering of the individual fibers. In all probability this also was hardened, thickened, and infiltrated with blood as were the outer and larger coverings.

The blood-vessels appeared perfectly natural from the *masséed* side, but from the side that had not been *masséed* they presented a hyperplasia or thickening of their external coat.

The nerve filaments were found to be natural in the *masséed*

side, while in the side that had not been *masséed* there were abundant evidences of neuritis, and perineuritis exerting destructive compression upon the nerve fibers. The perineurium, or sheath covering the bundles of nerve fibers, was at least three times as thick in the *non-masséed* side, and the connective tissue around the perineurium was also thickened with numerous new-formed cells. The small vessels in the perineurium were also the seat of a peripheral hyperplasia or thickening. The lesion of the nerves was more marked than that of the vessels.

These experiments of M. Castex give more emphasis than ever to the remarks of old Arrian in the year of our Lord 243, that "great is the advantage of rubbing to the dog, not less than to

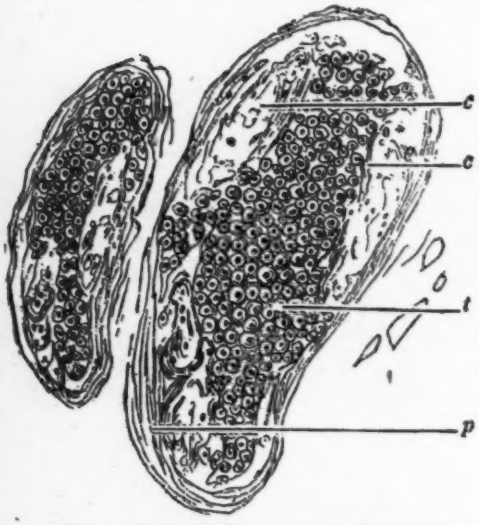


FIG. 3.—INJURED NERVE WITHOUT MASSAGE. *p*, perineurium; *t*, nerve tubes or fibers; *c c*, new-formed connective tissue.

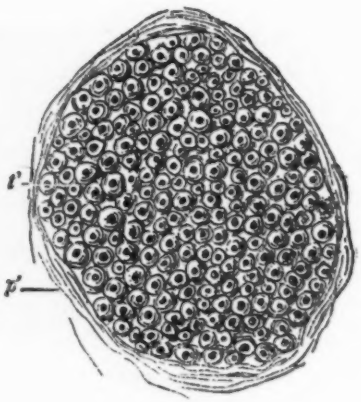


FIG. 4.—INJURED NERVE WITH MASSAGE. *p'*, perineurium; *t'*, nerve tubes or fibers.

In Fig. 4 all the nerve elements are of normal appearance, while the nerve elements from the *non-massied side*—Fig. 3—show that the perineurium is thickened, and underneath this there are deposits of new-formed connective tissue which crowd and compress the nerve fibers. (From the *Archives générales de Médecine*, Fevrier, 1892, p. 200.)

the horse, for it is good to knit and to strengthen the limbs, and it makes the hair soft and its hue glossy, and it cleanses the skin from its impurities. One should rub the back and the loins with the right hand, placing the left under the belly in order that the dog may not be hurt by being squeezed from above into a crouching position; and the ribs should be rubbed with both hands, and the buttocks as far as the feet, and the shoulder blades as well. And when they seem to have had enough, lift her up by the tail, and, having given her a stretching, let her go. And she will shake herself when let go, and show that she liked the treatment." (*Arrian Cynegeticus.*)

In human beings M. Castex found that when massage was begun early or from the very first in contusions, sprains, and dislocations not only were the immediate symptoms soon relieved, but also the subsequent serious consequences that are so apt to follow these injuries—wasting, weakness, contraction, and stiffness—were prevented. But when he tried massage in old cases of muscular atrophy or wasting following injuries to joints he got no increase of muscular tissue. The stiffness was got rid of; the muscles became suppler, but they still remained thin and lacking in strength. If he had combined passive and active movements with the massage he would probably have gained growth of muscle. He found that the galvanic and faradic currents were of benefit in promoting increase of muscular tissue. Muscular contraction produced by electricity is but another form of motion.

Numerous theories as to the cause of muscular atrophy from injuries to joints have been considered and abandoned. The most probable and most generally accepted is that of reflex action. The injury to the joint starts up more or less inflammation (arthritis); the articular nerves are irritated; this irritation is transferred to the spinal cord; the nerve centers affected act in turn upon the centrifugal nerves going to the muscles, and these determine at their peripheral ends the muscular atrophy. With a view to the elucidation of this, M. Deroche has repeated seven times, and always with the same results, experiments which were done for the first time at the College of France by MM. Raymond and Onanoff. He divided the posterior roots of the three last lumbar nerves on *the left side* in dogs and rabbits. After cicatrization had taken place he assured himself that numbness was complete from the thigh to the knee of the left lower limb, so that irritation of this region was not felt. The corresponding limb was left intact. An arthritis was then excited in both knees by introducing a thermo-cautery into them. *No pain was felt in the left knee,* but much in the right. Three months afterward the animals were killed, and in both knees the lesions of arthritis were found; *but the muscles of the thigh of the left leg were of natural size; of the right, atrophied.*

Prof. Simon Duplay and M. Cazin have also made a careful study of this subject in much the same way. Under the microscope they found that the articular filaments always presented signs of inflammation; but the large nerve trunks and spinal cord showed no appreciable change, and the results of the examination of the muscles were negative except as to diminution in size. They therefore concluded that muscular atrophies consecutive to joint injuries consist of simple atrophy, and that this can only be explained by a dynamic action, a simple reflex

due to irritation of the terminal nerve filaments of the articular nerves.

M. Deroche thought he found that the muscular atrophy was due to diminution of interfibrillary substance, and that there was an ascending degeneration of the posterior columns on the same side. However that may be, the inference is certainly justifiable that massage acts to prevent muscular atrophy by maintaining an influence, a movement, or something in the muscles which the spinal cord is for a time unable to impart to them; and in order to do this, it should be applied immediately or soon after the injury, for then it is more quickly aroused from the lethargy and stupor into which it has been plunged by the shock of the accident.

PEARLS AND MOTHER-OF-PEARL.

By CHARLES STUART PRATT.

AMONG the picturesque industrial possibilities of our southern Pacific coast is the artificial production of pearls. By this is meant, not the manufacture of artificial pearls, but the artificial growing of real pearls; that is, instead of the haphazard pearl-fishing of the present, the establishment, on the southern California coast, of oyster ranches, where the pearl-producing bivalves shall be scientifically directed and assisted in growing both gem pearls and mother-of-pearl.

This is hardly more visionary than was the recent establishment of ostrich ranches just inland from this same Pacific coast. A glance at the natural process of pearl-making will throw some interesting light on these oyster ranches-to-be. Mother-of-pearl is the natural product of the wild oyster, if we may so designate the bivalve of the unfenced sea bottoms. To secure a smooth surface for the contact of its soft, sensitive body, the oyster lines its coarser, rougher shell with a substance named nacre—which is simply carbonate of lime, with a trace of organic matter. This nacre is secreted and deposited in successive layers of filmy thinness and of marvelous smoothness of surface; the result is the lustrous, iridescent motherof-pearl.

Unlike mother-of-pearl, the gem pearl, round or otherwise, is an *un*natural product of the oyster. The gem pearl is an accident, almost a disaster, to its creator. In fact, a healthy, undisturbed oyster never produces a pearl. But if a sharp grain of sand finds its way inside the shell, the disturbed oyster protects its tender, sensitive flesh from the irritation of this offending substance by depositing about it smooth coatings of the nacre with which it has already formed or deposited the mother-of-pearl

lining of its shell. Layer after layer is added, until finally we have the round, lustrous gem for brides' fingers and the throats of queens.

It is possible that in some cases a wound throws off bony particles which become the nucleus of the pearl; or, in place of sand, the foreign substance may be a minute parasite, or a morsel of seaweed, or one of the tiny siliceous vegetables known as diatoms, or even one of the eggs of the oyster itself. Some such encysted particle, though perhaps of microscopic size, lies at the center, and was the cause, of every pearl. So the pleasure-giving gem is really the outgrowth of pain.

Now, it has been discovered that, instead of waiting the accidental intrusion of the alien particle into the shell of the oyster, grains of sand, or other objects, for the nucleus of the pearl, may be deliberately inserted by the hand of man, and that the oyster will at once set to work at pearl-making. It is known that the Chinese, from a remote period, have ingeniously taken advantage of this singular self-defense of the oyster. In the month of May the river mussels are taken from the water, and small pellets of clay, and even tiny images of the gods, are slipped inside the shells. The mussels are then replanted and left half a year. In November they are taken up again, and, while some of the shell-fish die, most have coated the clay pellets and little metal gods with nacre, producing real pearls and genuine mother-of-pearl deities.

These mother-of-pearl Buddhas are in great demand with the curious and the devout, but there is no evidence that any of the priceless pearls of the world have been so produced. And yet surely the results obtained suggest great possibilities for the enterprising man who shall establish the oyster ranches already mentioned, and who shall add to the ingenuity of the Chinese all the resources of modern science.

The thin layers of nacre are always deposited thicker in depressions than over elevations; hence uneven surfaces become level, and small particles of whatever form gradually become spherical. The perfect round pearl, however, can only result when the nucleus penetrates the soft body of the oyster, or remains unattached to the shell. Often it does become so attached, and when removed has a defect on one side, and can only be used in settings where that side is hidden; such pearls are called *boutons* or button pearls; odd, irregular shapes are called *baroques*.

Large or heavy intruding objects are quite likely to become attached to the lower half of the shell. Such objects often, in the course of years, are buried from sight under successive layers of nacre. Some Chinese Buddhas thus imbedded in the flat or lower halves of the bivalves are to be seen in London museums, and they

illustrate the curious fact that the oyster has the habit of forcing intruders out, not manlike through the door, but through the walls of its house. The way of it is this: while the successive coverings of nacre are deposited on the inside of the shell, the outside of the shell is gradually decaying and crumbling away, so that as the wall inside the alien object becomes thicker, the part outside becomes thinner, till finally the intruder reaches the surface—is literally forced through the shell of the oyster.

The pearl is the one gem that comes to us perfect from the hand of Nature, and to this its great antiquity as a gem is largely due. Precious stones whose beauty and brilliance depend on polishing and cutting would naturally be discovered and utilized later. The discovery of the diamond, for instance, probably dates within historic times. Though known earlier, it was not generally included among the gem treasures of royalty even as late as the seventh century. The modern cutting of diamonds in regular facets was invented as recently as 1456. Indeed, it is quite probable that the pearl was the first gem known and treasured by prehistoric man—since the search for food must have been the first occupation of the earliest of the race, and the shining pearl would thus have been discovered in river mussels if not in marine oysters. Certain it is that the Old Testament and the most ancient written histories allude to pearls, and that remoter evidence is found in the tombs and excavated cities of still earlier eras. The Egyptians, Babylonians and Assyrians held the pearl in an esteem verging on reverence.

Not only were pearls known and prized as the most precious of gems, but they were gathered and treasured in astonishing quantities by the early Oriental potentates. Many relics and records of those days remain. The crown of the Khan of the Tartars, captured on the Oxus by the Persians in the fifth century, was decorated with several thousand pearls. The famous crown of Chosroes, made in the sixth century, and which was strangely concealed for a thousand years in an obscure fortress among the Lauristanian Mountains, till brought to light by Shah Abbas, is incrusted with pearls in conjunction with rubies. In the seventh century the Arabs captured from the Persian nobles fabrics of amazing richness, among which was one marvelous carpet of white brocade, four hundred and fifty feet by ninety feet, with a border worked in precious stones to represent a garden of all kinds of beautiful flowers—the leaves of emeralds and other green gems, the buds and blossoms of pearls, along with rubies and sapphires.

The treasures of the Turkish nobility during some of the more brilliant reigns of the empire seem to belong to fable rather than to veritable history. Sinan Pasha, dying at eighty, left fifteen

strings of enormous pearls, and of "fine pearls" no less than sixty bushels!—accumulated during campaigns in Europe, Asia and Africa.

Shah Jehan, greatest of Mogul sovereigns after Timour, collected the wealth of India about him at Delhi, including the world-famous diamond known ever since as the Great Mogul. His was the famous peacock throne, the spread tails of the peacocks formed of precious stones to emulate the colors of the living bird, the whole valued at nearly thirty-five million dollars. Its canopy was fringed with pearls. His, too, was the Taj Mahal, the most marvelous tomb ever built, on which twenty thousand men worked for more than twenty years. And this Shah Jehan loved to wear round his neck priceless strings of immense pearls.

The Greeks and Romans rivaled the Orientals in their appreciation of pearls. When Alexander and his eighty companions wedded their beautiful Persian brides at the most famous marriage feast of history, the pearls of the Persian Gulf were the favorite jewels—as they are with brides in this closing decade of the nineteenth century. The Romans sent caravans on year-long journeys to Ceylon for pearls. And there is evidence that Julius Cæsar really invaded Britain for the sake of expected plunder in pearls. That he was not disappointed is shown by the record that on his return he dedicated to the Venus Genetrix a breastplate of the British gems.

The ancients seem to have had no conception of the real origin of pearls. Even in the days of the Romans they had not advanced beyond the early myths of creation by Vishnu, of angels' tears dropped out of heaven into the gaping mouths of mussels, or the diverse theory that they were as mystically congealed from dewdrops, which with equal mystery, after their ethereal descent, dropped through fathoms of water without commingling—unless, indeed, the shellfish were supposed to come to the surface to receive them. Pliny gravely asserts that "pearls are great or small, better or worse, according to the quantity and quality of the dew they have received. For, if the dew were pure and clear that went into them, then are the pearls fair and orient. Cloudy weather spoils their color, lightning stops their growth, and thunder makes the shellfish eject hollow husks or bubbles" in place of pearls.

Ceylon and the Persian Gulf, which were the chief sources of fine pearls back before the dawn of the Christian era, have retained their supremacy through twenty centuries, though profitable pearling grounds are now worked in Eastern waters off New Guinea and the northern Australian coasts, in the Sulu Archipelago, off Japan, and among the Polynesian islands. In minor quantity, and perhaps quality, pearls are gathered from Western

waters off the coasts of equatorial South America, the West Indies, Panama, and southern California. The Aztec kings possessed pearls of great beauty and price, obtained, it is supposed, from Panama. The palace of Montezuma, when despoiled by the Spaniards, is described as "studded with pearls," along with emeralds.

Some fine pearls are produced in inland waters by the fresh-water mussel (*Unio margaritifera*). Most of the river pearls are found in China, though at some periods the pearl industries in England and Scotland have been important. The rivers of Germany and parts of Russia are also pearl-producing. The principal river-pearl fishery in the United States is in the Little Miami in Ohio.

The marine mollusks yielding pearls are the *Avicula* (*Meleagrina*) *margaritifera*, *Avicula macroptera*, and *Avicula fucata*.

In the Persian Gulf the *Avicula fucata* is specially fished for gem pearls, as it produces more and of finer quality than the other varieties, though it is smaller and of less value for the mother-of-pearl lining of its shell. All three varieties mentioned, however, are found on the famous Great Pearl Bank, which lies along the west coast of the gulf. There the pearling industry from remote times has so dominated the people that it has passed into a proverb, "All are slaves to one master, Pearl."

The great Ceylon pearl fisheries are now a monopoly, under the supervision of the British Government, as formerly under that of the Portuguese and the Dutch. The fishing seasons occur at irregular and infrequent periods, only half a dozen having been sanctioned by the inspecting officer in the quarter century between 1863 and 1887. The value of the pearls from these several fishings varied from fifty thousand to three hundred thousand dollars, with a total of about one million dollars. The Ceylon fishing season runs from four to six weeks. The latest of which there is data was that of 1889, when in twenty-two days fifty divers brought up eleven million oysters, which yielded the Government fifty thousand dollars and the divers about fifteen thousand dollars. In Ceylon it is the custom to land the cargoes of oysters on the shore to die and decay. When sufficiently decomposed they are opened and then washed and searched for the more valuable loose pearls, after which the *boutons* are clipped from the shells, and the larger of the shells themselves selected for their mother-of-pearl.

Diving for pearls is perhaps the most perilous of occupations, with the possible exception of its antithesis—that of aëronautics. There are the terrible physical tortures of the first descents from the pressure of water; the bleeding from nostrils, ears and mouth; the bursting of small blood-vessels in the lungs; and the

rending of a way from ear to nasal passage. Nearly all divers become partly or totally deaf. Incipient heart and lung troubles are quickly developed to a fatal end. Paralysis is often induced. Sharks occasionally devour the naked natives; such tragedies are not common, however, since the splashing and constant agitation of the water serve to keep them at bay—though, no doubt, the natives themselves would credit their immunity to the shark-charmer who accompanies each boat.

The native crews off Ceylon usually include ten divers, five of whom rest while the other five are diving. Each man has a diving stone, weighing perhaps forty pounds, to which is attached a rope long enough to reach the bottom, and having a loop for the foot. The diver slips his foot into the loop at the sinking stone, inhales a full breath, compresses his nostrils with his left hand, raises his body as high as possible, and sinks swiftly to the bottom, feet foremost. The average depth for native divers is fifty feet, the greatest depth about seventy-five. The naked diver must work with great rapidity, as he can remain at the bottom only about fifty-five seconds. In spite of stories of divers remaining below for three or four minutes, the best divers rarely reach eighty seconds, and few exceed sixty. In this brief period such shells as can be secured are thrust into the shell-bag, net, or basket, the tender in the boat is signaled by the line attached, and the diver assists his own ascent by seizing the bag line as it is drawn up.

In the Persian Gulf the ancient custom of stopping the ears with cotton saturated with oil and closing the nostrils with pincers of tortoise shell is still in vogue. But the primitive method of diving is now being superseded by scientific diving in the modern diving dress. This consists of a rubber-cloth suit in one piece from foot to neck. The hands are bare, the elastic wristbands of the dress hugging tight enough to exclude water. The neck is large, of course, to admit the body after the feet and legs. The diver once in this dress, the neck is fastened between the double rims of a brass corselet, and then a big copper helmet is set over the head and screwed to the corselet. The helmet has glass windows at each side and in front, an air-tube entering at the back through which air is supplied by a pump worked by a couple of men in the boat, and a valve at the side for the outlet of vitiated air. The armored diver wears leaded canvas or leather boots weighing fifteen or sixteen pounds, and a couple of heart-shaped leaden plates over chest and back weighing twice as much more. He has a life-line fastened to his right foot and then by a slip-noose about his waist. This life-line is held by a "tender" in the boat who answers signals: one jerk, pull up; two, more air; three, lower bag.

The armored divers are mostly white sailors, Germans, Swedes, a few English, and an occasional American; and so great is the advantage of the diving suit that one armored diver is considered equal to a whole crew of natives. Instead of a swift, breathless struggle of fifty or sixty seconds, at a depth of fifty feet or less, with a limit of seventy-five, the armored diver can work for ten minutes at a depth of a hundred feet, while at a depth of thirty he can work for a couple of hours. The deep-sea dangers to which the naked diver is exposed are mostly shared by the armored diver. The protection from the tremendous crushing pressure of the water afforded by the suit and the cushion of inclosed air is offset by the increased pressure at greater depths. The armored diver likewise encounters the venomous stonefish. This little fish punctures the hand reaching for a shell and injects a poison which causesthe whole arm to swell, with great pain. The remedy is to remain down, as the pressure of water induces free bleeding at the wound, and the consequent outflow of the poison. If the bitten diver comes to the surface, as the unarmored diver must, the arm swells rapidly, turns black, and is painful for weeks.

Sharks do not attack the armored diver, but he has peculiar perils which the naked native diver escapes. At some great depth the air-pump may not work, or the air-pipe may burst. But there are greater dangers yet. Pearl oysters are not found in beds, like our edible bivalves, but scattered over the sea bottom; hence it is the custom to beat up against the tide or current, and then let the lugger drift, with a drag-anchor perhaps. Yet sometimes the drifting boat is seized by a strong current and whirled along, and then, while the diver hurries on to keep up, his life-line or air-pipe may become fatally entangled in branching coral; or, again, a slack line or pipe may fall into the jaws of the "giant clam," which close over it, and hold the diver prisoner to his death, alone in the dim ocean depths.

The most perfect pearls are found within what is called "the mantle" of the mollusk, an elastic membrane which envelops the oyster, and which is supposed to secrete the nacreous fluid. The finest specimens lie near the lips of the shell, or are imbedded in the softer part of the oyster near the hinge of the shell. The ideal gem pearl is spherical, white, without blemish in texture or "skin," with pure "water" or appearance of transparency—though no pearl is really transparent—and of distinguished lustre or orient. Lustre is the soul of the pearl, as brilliancy is of the diamond. Finely formed drop shapes, and then oval or egg shapes, are but little below the spherical pearls in value, if of equal perfection. The fine gem pearls are the size of peas; very much larger specimens, of twenty-five grains and upward, of perfect quality, are rare, and command corresponding values.

At the breaking up of the French crown treasury in 1791, a superb spherical pearl of large size sold for forty thousand dollars, and two pear-shaped pearls, weighing two hundred and fourteen grains, were valued at thirty thousand dollars each. The Shah of Persia possesses one of the finest pearls in the world, worth three hundred thousand dollars. The Imam of Muscat has refused one hundred and fifty thousand dollars for one of his famous gems. Perhaps the most extraordinary pearl now known is in Mr. Beresford Hope's collection in South Kensington; it is two inches long, four in circumference, and weighs eighteen hundred grains.

When Rome ruled the world, a wonderful pearl worth four hundred thousand dollars was cut in halves for earrings for the Venus in the Pantheon. The pearl of the Cleopatra legend is said to have been of equal value—though if swallowed it must have been as a pill without sugar coating, since gem experts assert that no acid the human stomach could endure will dissolve a pearl; indeed, the most powerful acids known only discolor and destroy the outer layers of nacre after long immersion. Authorities do not agree upon this point, however.

While the white pearl is really the ideal pearl of all ages, fashion, local in place and time, has favored other colors for the hour. Rose-colored pearls have been the fad in Paris for several seasons, to the enriching of the Scottish fishers. The Chinese prize yellow pearls; and just now black pearls, if of perfect quality, command the highest price. The largest and finest black pearls come from the La Paz pearling grounds off Lower California, which also yield pink pearls.

The color of pearls, as well as the quality and especially the lustre, depends on the peculiar environment of the oyster, the chemical composition of the water. The inky fluid ejected by the great squid is believed to affect the color of pearls. Temperature and the health of the mollusk may modify the nacreous deposits. Be all this as it may, when the oyster ranches already alluded to shall be established on our California coast, we may well expect that, with the co-operation of chemical and biological science, marvelous results will be obtained in both the quality and color of pearls—any color being produced at pleasure. Women of fashion and wealth will then order their pearls a season ahead, to be grown of desired form, lustre, and color, to harmonize with their gowns, as to-day they order in advance the gowns themselves.

Artificial pearls, which only the expert is likely to detect, are made by coating the inside of thin glass spheres with a solution of liquid ammonia and the lustrous coating of the lower scales of the bleak and dace, filling the bulb with melted wax,

and then subjecting the surface to the action of hydrofluoric acid. This was the invention of Janin, Jacquin, or Jalquin, a rosary-maker in Paris, in 1680. A thousand fish yield less than an ounce of the "pearl essence," which is correspondingly costly. The cheaper so-called Roman pearls have a lustrous coating on the outside, but bear little resemblance to real pearls, or even to the artificial pearls just described.

Considering the vast values in gem pearls obtained from the Eastern fisheries, it is surprising to find that the plain, unromantic mother-of-pearl secured is of even greater worth. Previous to the discovery of the extensive Australian fishing grounds, in 1865, the supply of mother-of-pearl was diminishing, while the demand was increasing. The large-shelled species already mentioned are there found in fine quality. The shells are the size of large soup-plates, weigh a pound each, and are worth about a dollar a pair. An expert diver, in diving dress, will collect three or four-hundred pairs in a day. About a hundred gem pearls are found in every ton of these shells.

Beautiful art work in carved and inlaid mother-of-pearl has long been produced in China and Japan. Some idea of the extent of its European use in the arts and manufactures may be had from the fact that eight thousand people are engaged in working mother-of-pearl in Austria, and half that number in France, while the value of the annual import into England is nearly one and a half millions. In the Philippine Islands windows are made of mother-of-pearl; and James Anthony Froude, in his volume of voyaging in Oceana, describes frightful Maori idols with slips of mother-of-pearl glittering in their eye-sockets; while in Cashmere it is the custom to inlay the inscriptions in tombstones with the same exquisite substance. To cap the climax of curious uses of the lustrous nacre, it is said that large quantities of seed pearls are imported into China to be calcined into medicines for the Celestials.

ACCORDING to M. Brau de Saint-Pol Lias, the Society of Arts and Sciences of Batavia has given special attention to the reconstitution of the most ancient of the Oceanican languages, the Kawi, which is probably the mother language of all the region. The Kawi inscriptions, in which William von Humboldt was much interested, are found everywhere in the islands; on the rough cliffs, on cut stones, buildings, statues, plaques of gold and silver, coins and medals; and many grand ruins of its people are found in Borneo, Sumatra, Bali, and especially Java. The language is still preserved in the legendary songs of the Javanese, as they are sung in their theaters, although it is not understood. Through the studies of the Batavian scholars the alphabet has recently been deciphered, and the meaning of two hundred words out of five hundred determined, while one hundred words are still in doubt, and two hundred are wholly undefined.

SKETCH OF JACOB MOLESCHOTT.

By Prof. E. P. EVANS.

THE distinguished physiologist, JACOB MOLESCHOTT, was born August 9, 1822, in Hertogenbush,* the capital city and chief commercial and industrial center of North Brabant in Holland. His father was a physician of some note, and his paternal grandfather a reputable apothecary; on his mother's side he was the grandchild of the celebrated Dr. Van der Monde. His mother was a woman of superior culture and refinement, and she and her more sedate and scientific husband devoted themselves with conscientious care and excellent discretion to the early education of their child.

The Moleschotts were originally Catholics. In 1797 the grandfather's dwelling, together with his large apothecary shop and storehouse, which contained a hundred thousand florins' worth of Peruvian bark and other medicaments of great value, was burned to the ground, thus reducing him at once from a state of affluence to extreme poverty. Not one of the many priests, who had constantly enjoyed his generous hospitality, lifted a finger to help him in his distress. A few prominent Protestant citizens came to his aid, and by their timely efforts enabled him to resume his business, which he carried on with such success as partially to retrieve his fortune, so that when he died in 1838 he was a comparatively wealthy man. The unsympathetic conduct of his coreligionists made a deep impression upon him as well as upon his son, who was then a child, and instead of pursuing his studies at the Catholic seminary at Warmond, he entered the University of Leyden, to which he was especially attracted by the eminent humanist, Prof. Daniel Wyttenbach, a man as conspicuous for learning as for breadth and freedom of thought. The influence exerted by this liberal thinker and scholar was wholesome and permanent, and decisive in determining the future intellectual character of the Moleschott family.

In his fifteenth year Jacob Moleschott was sent to the Prussian gymnasium at Cleves, not far from the Netherlands frontier, where he remained five years. He was then matriculated as a student of medicine and natural science in the University of Heidelberg.

At the solicitation of Nägele, Moleschott prepared a dissertation on a pathological problem which had been already discussed by the professor, but which could be definitely solved only by the

* ['S Hertogenbosch (the Duke's Bush) was originally a hunting seat of the Dukes of Brabant; hence the name.]

aid of the microscope. The difficult task was performed to the entire satisfaction of Nägele, who took occasion to express it in a peculiar manner. As Moleschott was returning for the first time from clinical practice in the lying-in hospital, for which he had paid the required fee to the secretary, Nägele accompanied him, and, as they were going downstairs, stuck the amount of the fee into Moleschott's vest pocket with the remark, "*Clericus clericum non decimat* (Clergy does not take tithes of clergy)."

In 1844 the Teyler Society of Harlem offered a prize for the best dissertation on Liebig's theory of the nutrition of plants, which formed the basis of his application of chemistry to agriculture, and which at that time excited as lively discussion in the scientific world as did Darwin's theory of the origin and evolution of species fifteen years later. Moleschott took a deep interest in the subject and was urged by Delffs to compete for the prize, which was also awarded to him. His dissertation contained a thorough examination and keen analysis of Liebig's views, and pointed out some instances of hasty generalizations and unwarranted conclusions. Moleschott exposed these logical fallacies and showed how largely they entered into the reasoning and vitiated the deductions of the distinguished chemist. The copy of the prize essay sent to Liebig was accompanied by a note in which Moleschott, while venturing to criticise his views, expressed the warmest admiration and enthusiasm for his personal character and scientific achievement. Liebig replied, thanking him for the essay, and added: "So far from being offended by opposition, I desire it, since it serves to separate the grain from the chaff; and I have all the more reason to be satisfied when this is done, as in your case, in a clever and gentlemanly manner."

On January 22, 1845, Moleschott passed his examination, and was promoted to the degree of Doctor of Medicine, receiving the first rank. But in order to practice his profession in Holland it was necessary to have a certificate of proficiency also from a Dutch university. For this purpose he went to Leyden, where he passed the so-called *colloquium doctum*, which consisted in a pleasant conversation with professors of the medical faculty—Broers, Pruys van der Hoeven, and Suringar—on the endemic diseases of Holland. He then established himself in Utrecht.

In connection with Donders and a Jewish physician, Van Deen (afterward professor in the University of Groningen), Moleschott founded a scientific journal for the publication of the latest researches made by Hollanders in anatomy and physiology, to which Mulder, Harting, Jansen, Van den Broek, Kees Verloren, Eduard von Baumhauer, and others sent valuable contributions. Notwithstanding the congeniality of many of his associations and his interest in these investigations, he was not contented with his life and

prospects in Utrecht. One day a Protestant clergyman paid him a visit and, after speaking in flattering terms of his professional ability and success, expressed regret that Moleschott did not attend church, and promised, on this condition, to recommend him to the members of the congregation. Moleschott thanked him for his good opinion and kind intention, but positively declined to pretend to worship God in the service of Mammon.

Moleschott's predilection for scientific research became more and more a passion to him. He determined henceforth to make a specialty of the study and teaching of biology in the broadest sense of the term as the science of life, and for this purpose habilitated as *Privatdocent* in his *alma mater*, the University of Heidelberg. No sooner was his intention made known than he was offered the position of Lecturer on Medical Jurisprudence in the University of Utrecht, which, however, had no attractions for him.

The subject chosen for his first course of lectures at Heidelberg in the summer of 1847 was physiological chemistry, and, although his audience was small, it comprised a number of students who afterward became scientists of distinction. As the fees for lectures furnished only a scanty source of revenue, he was compelled to keep up a limited medical practice and to devote himself earnestly to literary work. One of his first tasks of this kind was a thorough revision of the volume on foods in Prof. Tiedemann's elaborately planned but unfortunately never completed Manual of Human Physiology, which he undertook at the request of the venerable author.

On March 14, 1849, Moleschott married Sophie Strecker, the eldest daughter of a prominent citizen of Mayence, who entered heartily and intelligently into her husband's special studies and proved to be an efficient helpmate in catching and preparing frogs for experimental purposes, and aiding him in his microscopical observations.

In a course of lectures on the blood and its constitution, especially as to the effects of different kinds of food upon the relation of the white to the red corpuscles, Moleschott was assisted by seven students, who volunteered to undergo the necessary experiments. They came in the morning without having eaten anything and then partook of the prescribed diet, whose nutritive qualities were to be tested by an analysis of the blood. If eggs and other albuminous fare, roast meats, and peas were served, all was well; but if the meal consisted merely of potatoes and apple sauce, the youthful votaries of science, after their work was done, returned to their homes with ravenous appetites and pillaged cupboards and kitchens, so that the cooks in their respective families began to gossip about the queer sort of hospitality shown by that Dr. Moleschott, who invited the young men to dine with him and

insisted that they should come with empty stomachs, and then sent them home as hungry as wolves. About this time he also succeeded in demonstrating that frogs exhale more carbonic acid in the light than in the dark, thus proving that light accelerates the processes of assimilation in animal organisms, and that, too, independently of the temperature of the environment or the motion of the animal.

Meanwhile he had prepared and published his *Lehre der Nahrungsmittel* (Erlangen: Enke, 1850). This work, of less than two hundred and fifty pages, written "*für das Volk*," and admirably adapted to convey popular information concerning the digestive qualities and nutritive properties of common articles of food, was favorably received, and in a few years passed through three editions. It presented in a clear and concise manner the results of researches embodied in his *Physiologie der Nahrungsmittel*, issued a few months earlier and intended for physicians and naturalists, and was translated into Dutch, English, French, Italian, Spanish, and Russian. It is divided into three principal parts, the first of which treats of the general metamorphosis of matter in living organisms, the origin and formation of the blood and of the solids in the human body, the processes of assimilation, segregation, and excretion as the conditions of growth, and the physiological nature of hunger and thirst as sensations which inform the brain through the medium of the nerves that the blood is being impoverished. In the second part he shows how this impoverishment is checked and the waste repaired by nutriment, of which the various kinds—meat, eggs, bread, cake, peas, beans, lentils, potatoes, beets, cabbage, and other vegetables, and different sorts of fruit—are discussed as to their alimentary functions and value. We then have a chapter on drinks—water, milk, tea, coffee, chocolate, beer, wine, and brandy—and another on spices, or rather on condiments, in which are included not only salt, pepper, mustard, ginger, and other spices, but also butter, olive oil, vinegar, sugar, and cheese. In the third part there are rules of diet in their application to man as a not strictly omnivorous, but largely multivorous microcosm, with remarks on breakfast, dinner, and supper, nutriment for infancy, youth, middle life, and old age, for women, workmen, artists, scholars, and other persons of sedentary habits, and the different sorts of food suitable for summer and winter. All these points are discussed in a series of short sections with a perspicacity and perspicuity and power of condensation rarely combined in scientific treatises. This feature of the work was especially praised by Alexander von Humboldt.

Perhaps even a greater sensation than by the book itself was made by a long review of it in a Leipsic weekly journal (*Blätter für literarische Unterhaltung*, November 9, 1850), by Ludwig

Feuerbach, who summed up its teachings in the pithy phrase, "*Der Mensch ist was er isst*" ("Man is what he eats"). A similar utterance is that with which Moleschott closes the chapter on the nutritive properties of leguminous plants: "*Ohne Phosphor, kein Gedanke*" ("Without phosphorus no thought").

Moleschott's book had a socialistic as well as a scientific character, although this feature was hardly recognized by his contemporaries and critics. It indicated the direction which European legislation is now taking to solve the social question, namely, through the stomach, by making better and surer provision for the present and future wants of the working classes.

About eighteen months later Moleschott published his *Physiologie des Stoffwechsels in Pflanzen und Thieren* (Erlangen: Enke, 1851), of which Humboldt, in a letter dated November 30, 1851, expressed his warm appreciation and hearty indorsement. This work, however, was only preliminary to another of wider scope, entitled *Der Kreislauf des Lebens: Physiologische Antworten auf Liebig's chemische Briefe* (Mainz: Zabern, 1852; fifth edition, 1887), consisting of a series of twenty letters on revelation and natural law, with strictures on Liebig's confusion of these conceptions, the sources of human knowledge, the eternity of matter, its gradual evolution, constant circulation, and endless transformations in the growth, decay, and renewal of animal and vegetable life; force as an essential and inseparable quality of matter, especially as regards the functions of the brain in their relations to the faculty of thought and the freedom of the will, and kindred topics.*

In the practical application of his theories Moleschott animadverted on the prevailing custom of burying the dead in permanent cemeteries, where their bodies decay with no advantage, and often with serious injury, to the living. "If every place of burial," he says, "after having been used a year, should be exchanged for a new one, it would become in the course of six or ten years a most fertile field which would do more honor to the dead than mounds and monuments." But, he adds, it would be still better if we could return to the ancient custom of burning the dead, which he declares to be unquestionably more practical as well as more poetical. By this process the air would be made richer in carbonic acid and ammonia, and the ashes, which contain the elements of new crops of cereals for the nurture of man and beast, would transform our barren heaths into luxuriant plains. At present, he adds, we are acting like the stupid and slothful servant who buried his one talent in the earth instead of wisely investing it so as to gain another.

* The latest editions of Moleschott's works, his *Kleine Schriften* (Minor Essays), *Vorträge* (Addresses), etc., are now published by Emil Roth in Giessen.

These views, while commending themselves to naturalists like Humboldt, Donders, Van Deen, Emil Rossmässler, Otto Ule, and Hermann Burmeister, and scholars like Strauss and Renan, gave great offense not only to the orthodox clergy but also to conservatives of every sort, to whom the cremation of the human body seemed as sacrilegious as its dissection did to the contemporaries of Vesalius three centuries before. As the result of a solemn conclave held by the senate of the Heidelberg University, the rector of that institution warned Moleschott that, unless he ceased to corrupt youth by his "immoral" and "frivolous" teachings, the *venia docendi*, or right to lecture, would be revoked. The sole fitting answer to such an ill-advised and impertinent admonition was given at once by Moleschott, who wrote to the Baden ministry severing his connection with a university in which liberty of instruction existed only in name. This decisive step was evidently an unpleasant surprise to those who had provoked it, and thereby raised a storm of indignation in scientific circles and in the press which they were wholly unprepared to meet. The young men who had just attended Moleschott's courses of lectures on anthropology and organology published with their several signatures an address to the ministry, in which they vigorously repelled these accusations and vindicated Moleschott's character as a man and teacher. In their daily intercourse with him they declared that they had never detected the slightest justification of the charges brought against him. In the communication of the results of his scientific researches there was not the faintest trace of the spirit of proselytism, but every one was left free to form an independent judgment in accordance with the facts.

Although no longer an academical teacher, Moleschott continued to reside in Heidelberg, working in his private laboratory, to which he also freely admitted all who wished to make experiments under his direction, and keeping his head financially above water by literary labor. Thanks to his calumniators, public attention was called to his books, and the sale of them greatly increased. He also founded a scientific journal entitled *Untersuchungen zur Naturlehre des Menschen und der Thiere*, which began to appear in 1855 at irregular intervals, and numbered among its contributors some of the most distinguished European men of science. Moleschott edited the first fifteen volumes of this periodical, or yearbook, as it might more properly be called; since 1892 it has been continued by G. Colasanti and S. Fesbini (Giessen: Emil Roth). He also published an exceedingly interesting monograph, *Georg Forster, der Naturforscher des Volks*, issued November 26, 1854, on the hundredth anniversary of the birth of this most remarkable man.

In the spring of 1856 Moleschott was appointed to the chair of Physiology in the University of Zurich as the successor of Karl

Ludwig, who had been called to Vienna. On June 21st of the same year he delivered his introductory lecture, the subject of which was Light and Life. It was printed as a pamphlet, which went through three editions. On his way to the lecture room he met the rector of the university, Hermann Köchly, who was not only an acute philologist but also something of a wag, and who assured him that the peasants, led by their pastors and armed with clubs, were coming down the lake to put a stop to such godless proceedings, just as a dozen years before they had overthrown the government that ventured to offer a professorship to David Strauss.

At that time the society of Zurich was uncommonly attractive, owing in a great measure to the presence of many political refugees from France, Germany, and Italy, whom the reaction which followed the Revolution of 1848 had driven into exile. Very pleasant, too, and stimulating were his associations with G. H. Lewes and George Eliot, who came to Zurich on purpose to visit him; with Varnhagen von Ense, Gottfried Keller, Princess Wittgenstein, Countess d'Agoult, and especially the geologist Eduard Desor, at whose country seat in the Jura, Combe-Varin, a select circle of congenial spirits met from time to time for the interchange of thought and the discussion of scientific questions. Among those who were wont to assemble under Desor's hospitable roof besides Moleschott may be mentioned Carl Vogt, Charles Martin, Jacob Venedey, Liebig, Schönbein (the discoverer of guncotton), Dr. Hans Küchler (a German Catholic parson), and Theodore Parker, who spent the summer of 1859 in the Alps for the benefit of his rapidly failing health. At these meetings papers were read, and Moleschott speaks in the highest terms of one by Parker, entitled A Bumblebee's Thoughts on the Plan and Purpose of Creation, an exceedingly acute and amusing persiflage of the anthropocentric theory of the universe. These essays form the contents of Desor's Album of Combe-Varin, a unique memorial volume of about three hundred pages. Moleschott and Parker often differed in their ideas, but entertained the warmest regard for each other as earnest and honest seekers after truth. Curiously enough, a peculiarly strong attachment sprang up between Parker and Küchler, the radical Unitarian and the German Catholic, who used to sit for hours in conversation under an evergreen tree, a fit symbol of their lasting friendship and now known as "Parker's Fir." *

* Moleschott's charming autobiography, *Für meine Freunde* (Giessen: Emil Roth, 1894, pp. 326), gives a pleasant account of the days spent with Desor and his illustrious guests at Combe-Varin. Indeed, these personal reminiscences are most delightful reading, and it is to be regretted that they have remained a fragment extending only to 1860, and thus comprising but a little more than one half of his life. The life at Combe-Varin is also described in Alfred Altherr's *Theodor Parker, in seinem Leben und Werken* (St. Gallen:

In the autumn of 1861 Moleschott was called by Cavour to the chair of Physiology in the University of Turin. In 1876 he was made senator of the kingdom of Italy, and in 1879 appointed to a professorship in the newly organized University of Rome, where he united with his academical duties and senatorial functions an extensive practice as a physician. There he died, May 20, 1893; and, although more than threescore years and ten, he was constitutionally so robust that his death may be said to have been premature. Like his father, he fell a victim to overwork and exposure in the conscientious exercise of his profession. During the last twenty years of his life he devoted himself also with laudable zeal and marked success to the land of his adoption in the promotion of education and the sanitary improvement of the Italian capital and other cities of the realm.

Moleschott was not only an able and painstaking specialist but also a man of broad culture, an excellent musician, a connoisseur in art, and a keen observer and intelligent critic of all the social, political, philosophical, and theological movements of the age. Whatever concerned the progress of knowledge and the perfection of humanity enlisted his sympathies and secured his support. He was a good linguist, and wrote and spoke French, Italian, and German with rare correctness and facility. The greater part of his works were composed originally in German, which he preferred even to Dutch, his mother tongue, as a medium of literary and scientific communication; but, unlike most German authors, his style is wonderfully clear and succinct, and wholly free from the awkward involutions into which the peculiar genius of the language, its very vitality and plasticity, are apt to tempt the unwary scribe. Moleschott was saved from this fatality by his artistic sense of proportion. In his treatment of a subject he had the rare gift of knowing what to put in, what to leave out, and when to stop. He was a "full" man, in the Baconian use of the term, but was mentally too well poised to slop over. He had inherited a hasty temper, but had learned in early life to keep it under control, and this natural sensitiveness under proper discipline rendered him a most charming and sympathetic companion in his intercourse with his family and his friends. Above all, he was thoroughly honest and sincere, and never permitted personal feeling to warp his judgment; in his controversies and criticisms he was generous and just, welcomed the truth from every source, and did not show the slightest disposition to ignore or depreciate the merits and achievements of an adversary.

Wirth, 1894, ix, pp. 404). The author is the pastor of St. Leonhard's Church in Bâle. We may add that photographs of Moleschott, of a cabinet size, may be procured from his publisher, Emil Roth, in Giessen, for one mark, or twenty-five cents.

Correspondence.

CHARACTER-BUILDING AND THE ENVIRONMENT.

Editor Popular Science Monthly:

SIR: Your editorial entitled Necessity, in the April number of the Popular Science Monthly, attracted my attention, and as a general statement this much of your conclusion commands my approval: "In every well-balanced mind the thought of necessity is habitually present, calling forth efforts of self-restraint which tend to conserve and consolidate the individual's happiness and well-being. We contemplate, therefore, a constant recognition of necessity, but a recognition which enables a man to meet it on ground more or less of his own choosing."

Your more special conclusion, however, does not appeal to my reason as having any great value as a *practical* proposition. I refer to the following: "The problem is to make more sound individuals; and that problem does not seem to be in its nature insoluble—therein differing from some that are set by social reformers." The value of this proposition depends wholly upon the meaning of the term "sound individuals." If in defining this expression you include as an essential characteristic of "sound individuals" a knowledge of the meaning and application of the law of equal freedom, as taught by Herbert Spencer, your proposition is of unquestionable validity; although it would still be of no great *practical* value without pointing out the *specific* manner of making individuals sound relative to the particular necessity they have to face; the necessity which you appear to have had in mind in this case being their social environment.

You say: "Socialist writers do not appear to be at all of this way of thinking. They have a noble zeal for remedying evils, but they do not seem to allow anything for the conditions which Nature itself imposes." This is a blunder for which defenders of our present semi-socialistic society are equally responsible. There is no more imperative and unchangeable condition imposed by Nature than the law of rent. Henry George has shown, in Progress and Poverty, that private appropriation of rent is the world-wide cause of involuntary poverty. His book has been before mankind nearly twenty years, and there is not to-day a review of it extant worthy of being classed under the head of scientific investigation and criticism. All attempt at criticism of Progress and Poverty *as a whole* is mere pettifogging.

Rent is a social product. The exclusive possession of land is a special privilege granted by society. Society should realize one hundred cents on a dollar for its resources. Instead of so doing, it squanders them, gives them away. In throwing away its resources Government pursues a course that would bankrupt any private business. But, unlike private individuals, it has the power to recoup its losses by force, by preying upon individuals—taking their property without giving anything in return. In so doing it violates all the laws of equity and propriety fully recognized in private transactions. Men in dealing with each other give value received, or at least make a pretense of so doing. Government, however, does not even make the pretense, but takes our personal property by force without even claiming that the tax is in proportion to benefits conferred.

But this is the will of the ignorant majority, also of pretentious scientists and teachers of *morals*. My first prescription for making "sound individuals" is to teach them the good old maxim, "Equal rights to all, special privileges to none," and then to show them the *application* of this principle to society's administration of the land.

Your criticism of socialism, and any scheme whereby employers would be *compelled* to hire the unemployed, is valid. Single taxers, however, ask only that the unemployed have *equal access* to natural opportunities. Granted that those having more capital can make better use of natural opportunities, but where does capital itself come from? With *equal access* to the land, whence capital is derived, men would quickly employ themselves, and would soon provide themselves with capital; if they did not, they could make no reasonable complaint.

You say: "The more, for our own part, we look into these questions, the more we are driven back to the conviction that the way out which is so much desired lies in the improvement of individual character, with consequent increase of individual power and better adaptation to surrounding conditions. As it is, we find that the well-developed individualities can take care of themselves pretty well; they have the power of adapting themselves to their surroundings, and taking so useful a part in the world's work that, even under the much-abused capitalistic system, they thrive very well."

When men arrive upon this earth, as millions do, and find it owned and their right to equal access to it denied, they are undeniably at about as great a disadvantage as it is possible to conceive; and it is worse than mockery to tell them that "the way out

which is so much desired lies in the improvement of individual character, with consequent increase of individual power and better adaptation to surrounding conditions." The thing to tell them is *to change the surrounding conditions so as to remove the disadvantage.* It is true that a small percentage of well-developed individualities, especially if they manage to get possession of some of the special privileges created by law, thrive very well; but this percentage is so small as to be hardly worth considering when studying the welfare of the human race.

You advocate the doctrine of contentment. You would say that an engineer, for example, obtaining for his services five thousand dollars per annum, was thriving very well. Perhaps another person, utterly regardless of his *natural* individual power, is in possession of an income of one hundred thousand dollars per annum, derived solely from special legal privileges, without rendering any service to society. The latter represents a class who are parasites upon the former. The question is, *How much better would the engineer thrive if the legal privileges supporting the parasite class were abolished?* Another question suggests itself. Suppose a large number of the individuals of low productive power should follow your advice and become, for example, competent engineers, how well *then* would good engineers thrive? Would not competition immediately bring down the incomes of engineers? The privileged classes would simply have better educated servants, and would get them for less pay.

You say: "We are far from saying that there is not a vast amount of hardship in the world, and much of it of a kind which in no way benefits those who have to endure it, as, of course, some hardship undoubtedly does. But we want to see a way out that will not cut the nerves of industry and make self-reliance a forgotten virtue. We want to see a way out that will not lessen the sense of individual responsibility or make a man less a man. Show us such a way, and we shall gladly lend every effort in our power toward its realization."

The writer is very glad indeed to feel that he can give you credit for being sincere, and that your attitude toward the single-tax movement results from a misconception of it, notwithstanding the immense amount of circumstantial evidence pointing to the so-called "conspiracy of silence" of the press, due to its subjection to the privileged classes. Believing as I do that you greatly misconceive the single-tax proposition, I can not blame you for not offering its accredited representatives a full hearing in your conservative journal. In the interest of our movement and accepting your invitation, "Show us such a way," etc. I offer the services of myself and others in the movement to endeavor by private and confidential correspondence, or interviews if you prefer, to try to remove from your mind what we very plainly see are gross misapprehensions of our principles and aims. As a scientist you can hardly do less than give the subject this much consideration. As a journalist, however, we can not expect you to admit anything that you regard as visionary quackery. It is only in the hope that we may so far remove your misconceptions that you will see the propriety of admitting fair presentations of the single-tax proposition in your journal that I am writing you.

I am aware that very many of our advocates mix with their arguments a great deal of religious dogma and superstition and crude notions of "natural rights," etc. The writer, however, claims to be wholly free from these ideas and superstitions, and holds that they are entirely superfluous in presenting the single-tax proposition. I ask only for pure scientific treatment. If the single-tax doctrine can not be logically deduced from the accepted laws of political economy and ethics, or if it can be shown that the conclusions of those sciences invalidate the single-tax proposition, the writer stands ready to abandon it. Yours, etc., L. G. BOSTEDO.

CHICAGO, *April* 12, 1896.

Editor's Table.

SUMMER HOLIDAYS.

THE time is at hand for the annual migration from the city to the country or the seaside of all whose means enable them to allow themselves that pleasure. There is doubtless something more than fashion in the movement, for fashion is arbitrary and changeful, while the habit we speak of has been steadily growing in generality for the last half century or more. If we seek for the philosophy of it we may reasonably regard it as the expression of a periodical craving of human beings for closer contact with Nature than

the conditions of city life permit. The works of man, the monuments of civilization, in the end oppress us, and we turn for refreshment and expansion to the wider landscapes, the purer air, the freer life of regions as yet comparatively untamed. This is the most satisfactory view to take of the matter, and happily it is one of wide application. With many, however, there is no desire for an escape from the conventionalities of life, and no hunger for a reposeful contemplation of the beauties and grandeurs of Nature. The excitements of society may jade but do not satiate them, and, in their flight from the city to the seaside or mountain resort or to foreign lands, what they seek is still the excitement of society in new forms and under new conditions. With such we have no concern; no words of ours would be likely to reach the circles in which they move, nor, if they did, would they be in the least likely to secure a moment's attention.

Much benefit, in our opinion, is to be had from summer holidays if rightly used, and it can not but be a matter of regret to every sympathetic man and woman that so large a body of social toilers should be condemned to year-long imprisonment in the cities, varied only by such brief excursions to outlying points as the present improved conditions of local transit may place within their reach. The maximum of benefit from a holiday comes only to one who has earned it by faithful work. If, with mind and heart free, such a one can allow himself a few weeks' residence in some healthful spot where the face of Nature is beautiful with field and forest, with hillside and running water, he is a man to be envied. It is not inactivity of mind or body that a healthy man will desire on such occasions—inactivity is only for the exhausted—it is new occupation for mind and body combined with a delightful sense of not being in a hurry. The wise man cast amid natural scenery and conditions will seek in some way to enlarge his knowledge of and sympathy with Nature, not in the spirit of scientific research, but rather in that of loving contemplation. It is a time for increasing one's familiarity with natural objects, for learning a little more by direct observation of leaf and tree, of bird and insect, of cloud and mountain, for becoming more sensitive to forms of beauty and the changing harmonies of the visible world, for the unsealing of the eyes and the unstopping of the ears and the enlargement of the heart. From such intercourse with Nature, coupled with wholesome modes of life, there can not fail to flow much benefit, mental, moral, and physical. The mind gains in elasticity and apprehensiveness, the spirit in serenity, the body in tone and vigor, and summer holidays so spent are likely to prove the most fruitful part of the whole year.

It is the custom with some when they leave the city to lay in a stock of summer reading consisting chiefly of the "lightest" novels. This simply means that they still crave excitement, and must find it in ever-renewed pictures, however lazily gazed at, of the life of society—the life they have (in theory) left behind them. It seems to us that the books to take to the country, if we take any, are not new ones but old ones—those we have read before, but which still have their message and their charm, classics whose beauties we have not exhausted, and perhaps are not likely to exhaust, which recall old associations and help us to calmer and broader views of life. We lay down no rule for others; we merely suggest that there is more rest for the mind and spirit in going over old paths than in striking into new

ones. The new writers give us the last refinements and developments of thought, the latest paradoxes, and all that is up to date in style and expression; the old ones are better interpreters of primal Nature, and of what is broad and fundamental in humanity. In these pauses of life we should try to take to heart the lesson that Wordsworth teaches in his celebrated sonnet:

> The world is too much with us; late and soon,
> Getting and spending, we lay waste our powers;

and which a later poet echoes when he exclaims:

> The will to neither strive nor cry,
> The power to feel with others give;
> Calm, calm me more, nor let me die
> Before I have begun to live!

The Roman satirist Persius gives this pithy advice: "Dwell with yourself, and find out how little you really require." In our holidays it would be well, instead of pampering ourselves, to try to reduce life to its simplest, or at least to comparatively simple, elements. Thus can we best renew and rejuvenate our spirits, and bring ourselves to feel how little the joy of life depends upon the luxuries and artificialities of advanced civilization.

These are old ideas and have been much better expressed by many writers of note; but we are all apt to forget the good counsels we receive, and a timely reminder can do no harm. Particularly in a civilization so restless as ours and so avid of novelty, is a period of rest far from the hurry and turmoil of the city a matter of necessity. Otherwise what do we tend to become?—mere creatures of the moment, rushing from task to task or from amusement to amusement, hurriedly scanning the headlines of our papers or the illustrations of our magazines, constantly absorbed in the actualities and trivialities of life, and constantly tending toward a soulless materialism in thought and sentiment. If our civilization, however, is to count for anything serious in the great chain of human history, we must get more soul into it—we must strive to rise above the routine and mere mechanics of existence. We must find out and take the truth home to our hearts, that life is something more than meat, that the body is of more dignity than its raiment, and that the soul of man is destined for other and higher uses than simply to reflect the shows of the passing moment. Let us in our holidays, if we are so fortunate as to have any, try to baptize ourselves anew in the fresh fountains of natural beauty which almost every countryside affords, let us attune ourselves to the harmonies of Nature, let us get sight of our own souls, "our true deep-buried selves, being one with which," as one whom we all know has finely said, "we are one with the whole world."

MR. SPENCER AND THE METRIC SYSTEM AGAIN.

MR. HERBERT SPENCER is not one of those philosophers who think it a duty to hold severely and loftily aloof from practical and everyday questions. He is keenly interested in the daily life of the people in the widest sense of the word; and we may attribute to that fact the zeal he has recently displayed in connection with the proposition to make a radical change in the system of weights and measures now and for many generations established in England. Since we last referred to this subject Mr. Spencer has addressed two further communications to the London Times in relation thereto. The second of these we quote entire, as being a brief yet comprehensive statement, from the writer's standpoint, of the whole question.

THE METRIC SYSTEM.

To the Editor of the Times.

SIR: Arguments and expressions of opinion may be continued without end. Against those of Lord Kelvey and Dr. Stoney I will simply set some facts already stated, joined with one other.

1. Always mankind had the decimal system at their finger ends and used it for counting. In the course of civilization they departed from it in their systems of weights, measures, and values; gradually adopting instead sets of easy aliquot divisions, and especially duodecimal divisions.

2. For half a century after the metric system had been legally established the French did not discover its convenience. The alleged discovery of its convenience went along with the discovery that they would be punished if they did not use it.

3. In the United States, where the decimal division of money is used, it has been departed from in the center of most active business, the Stock Exchange, and a system of easy aliquot divisions employed in its place.

4. The additional fact not yet named is sufficiently striking. The ancient wise men of the East and the modern workingmen of the West have agreed upon the importance of great divisibility in numerical groups. The Chaldean priests, to whom we owe so much, doubtless swayed in part by their astronomical arrangements, adopted the sexagesimal system of numeration, which at the same time facilitates in a special manner the division into aliquot parts. For 60 may be divided by ten different numbers—2, 3, 4, 5, 6, 10, 12, 15, 20, 30. From this significant fact turn now to the fact presented in our ordinary foot rule. Each of its 12 inches is halved and rehalved, giving halves, quarters, and eighths. And then if we consider the subdivided foot as a whole, it gives us ten sets of aliquot parts. Beyond its 12ths the divisions yield $\frac{1}{24}$, $\frac{1}{32}$, $\frac{1}{48}$, $\frac{1}{64}$, $\frac{1}{96}$ ($1\frac{1}{2}$ inch), $\frac{1}{128}$ ($\frac{3}{4}$ inch), $\frac{1}{192}$ ($\frac{1}{2}$ inch), $\frac{1}{256}$ ($\frac{3}{8}$ inch), and $\frac{1}{384}$ ($\frac{1}{4}$ inch). And this ordinary mode of dividing the foot rule results from the experience of centuries; for builders, carpenters, and mechanics, always buying foot rules which best serve their needs, have gradually established the most useful set of divisions. Yet now, though the early men of science and the modern men of practice are at one in recognizing the importance of great divisibility, it is proposed to establish a form of measure characterized by relative indivisibility. I am, etc.,

YOUR CORRESPONDENT.

April 30th.

We must say that the arguments adduced by Mr. Spencer appear to us of much weight. On the whole, it would seem more probable that an approximately perfect system of weights and measures should be evolved in the course of age-long practice, than that it spring fully developed from the brain of any *savant* or body of *savants*. Weighing and measuring make up and have always made up, in one form or another, a considerable portion of the business of every day; and men naturally take to those modes of measurement and calculation which offer the greatest facilities for the work to be done. Their minds have naturally moved in the lines of least resistance, and the methods sanctioned by the history of the race express this mental tendency. It is therefore greatly to be desired that no change may be made either in England or in this country looking to a disuse of old established and popular methods without a very thorough and earnest consideration of the effects likely to be produced on the life of the people. The *savants* can follow what methods they find most suitable for the very exact researches and determinations which they are called upon to make; but they should be very careful how they call upon the people to abandon methods and instruments which for everyday purposes answer all their needs, while affording aids to their mental operations which it is extremely doubtful whether the arbitrary system it is sought to introduce can ever supply.

AN ALLEGED CONSPIRACY OF SILENCE.

WE publish elsewhere a letter by Mr. L. G. Bostedo, Corresponding Secretary of the Chicago Single-Tax Club, commenting on a brief article published in these columns last month under the title of "Neces-

sity." The writer evidently thinks that to talk as we did of making "sound individuals" without postulating, as a necessary condition thereto, the general adoption of current theories in regard to the nationalization of the land, is useless. We are not, however, quite of his opinion on this point. We are not sure that there would be a larger proportion of sound individuals if the land were nationalized than there is at present. It is easy to say that an era of general prosperity and well-being would set in if these theories prevailed; but the thesis has never been proved, and the world is by no means persuaded that it is true. Fifteen years ago the doctrine excited much more interest than it does to-day, and was fervently believed in by many who now have either abandoned it altogether, or else have come to attach only a secondary importance to it. Mr. Bostedo believes that there is a "conspiracy of silence" on the subject in the press. If there is, we are not aware of it; we have certainly never joined the conspiracy. What seems to us to be the case is that the public has got tired of a question which was very widely discussed some years ago, but without any very satisfactory result. Our correspondent speaks of this journal as "conservative." We trust we are conservative in a right sense, and liberal in a right sense also. We believe that the principles on which human well-being mainly depends are very old; but we desire at the same time to see the latest results of human thought applied to the improvement of the general condition of mankind. The question whether land should be individually appropriated is manifestly one into which we can not enter to-day; moreover, it is not one which is likely to be settled to every one's satisfaction at any early date. Meantime we think it right to point out, as we did in the article under consideration, that character and general fitness for the work of the world have much, if not everything, to do with happiness and success in life. We all know "sound individuals" when we see them; and we know that they spring from almost every condition of life. A very sound individual, who had endured considerable hardships in his youth, became President of this nation some thirty-five years ago. We want more of that kind, and we should not wait to get the land laws fixed or unfixed before doing what may presently be in our power toward increasing their number through such agencies as education, free and temperate discussion, and righteous government.

One thing pleases us in Mr. Bostedo's letter, and that is his declaration that he does not, like very many of the advocates of the single tax, mix up with his arguments "a great deal of religious dogma and superstition and crude notions of natural rights, etc." Perhaps the large extent to which single-tax writers have resorted to just such faulty modes of reasoning in the past has something to do with the alleged "conspiracy of silence." That kind of thing has a very silencing effect on people who wish to keep their wits clear and their tempers sweet.

Scientific Literature.

SPECIAL BOOKS.

UNDER the able editorship of Sir Henry E. Roscoe the Century Science series continues to afford popular biographies of the leading European scientists of the nineteenth century, written by those who are to-day filling the places of their departed masters.* The life of Lyell was a steady and comfortable progress in knowledge and fame. He did not have congenital poverty or other serious obstacle to contend with, and his talents were high enough and his opportunities broad enough to insure his efforts a rich reward. The English universities had little of science to give in the second decade of the present century, so that Lyell's training in geology was picked up from outside sources in vacations and during his few years of not very arduous practice of the law. Prof. *Bonney* gives us a vivid sense of the paralyzing influence which was still exerted upon geology and all other branches of science in Lyell's early life by the supposed necessity for making all discoveries in the realm of Nature conform to the language of the Scriptures. Lyell was always in the van of the advanced thinkers in his chosen field, and apparently maintained this position without open rupture with the theologians. In describing his epoch-making work, the Principles of Geology, Prof. Bonney says, "It proved the writer to be not only a careful observer and a reasoner of exceptional inductive power, but also a man of general culture and a master of his mother tongue." Doubtless his literary ability joined with a happy endowment of tact enabled him to contribute greatly to the scientific revolution which culminated in Darwin, without being pilloried as Darwin was. Most of the events of Lyell's life are given in chronological order, but the author departs from this plan to give in one chapter a connected history of the eleven editions of the Principles that appeared in Lyell's lifetime. That he was a scientist of a high order is shown by the fact that he was able to change his opinion on an important question late in life, namely, the origin of species, when such evidence as Darwin presented was brought to bear upon it. This conduct caused Darwin to write, "Considering his age, his former views, and position in society, I think his action has been heroic"; and Prof. Bonney estimates as perhaps a greater service than any of his contributions to knowledge the constant readiness of Lyell to learn from others, and the manifestation of a judicial mind raised far above all partisanship and pride of opinion.

It needs but a glance at the finely cut features and long, high-vaulted cranium represented in the portrait of *James Clerk Maxwell* to show that his biographer has to record the life and labors of a genius. No one but a genius could have united Maxwell's mathematical penetration with his poetical ability, and the fact that his intellect was not well rounded on all sides is also characteristic of genius. His chief defects were a weakness in analysis and an inability to bring his teaching down to the level of the

* Charles Lyell and Modern Geology. By Prof. T. G. Bonney. Pp. 224, 12mo.—James Clerk Maxwell and Modern Physics. By R. T. Glazebrook, F. R. S. Pp. 224, 12mo. London: Cassell & Co., Ltd. New York: Macmillan & Co. Price, $1.25 each.

ordinary student. Mr. *Glazebrook* tells the story of Maxwell's life in a little less than the first half of the book before us, devoting the rest to an account of his works. The first part is enlivened by a sprinkling of characteristic incidents, while many extracts from his letters and addresses, together with a few of his verses, help to show the real nature of the man. His scientific work is grouped under three heads: Color perception, molecular physics, and electrical theories. He made researches experimentally as well as by mathematical processes, and a spinning top carrying various colored disks of paper became in his hands a most effective piece of apparatus. His later views on the molecular theory are to be found in the articles Atom and Diffusion in the Encyclopædia Britannica, but more important than his achievements in the two foregoing subjects were his theories as to electricity and magnetism. What these were our author tells with considerable fullness, giving some history of the subject before Maxwell, and quoting frequently from Maxwell's papers. A concluding chapter shows how discoveries made since his death, especially those of Hertz, have firmly established his views. Throughout the volume the effort has been constant to give readers with little knowledge of mathematics a realizing sense of the truths of physical science discovered by Maxwell, but it was impossible to avoid some details which only adepts will appreciate.

IN the two parts of his recent book* Prof. *Zahm* has performed two services for Christians, especially Catholics, who are not quite clear as to what evolution is, and are concerned about the alleged conflict between this doctrine and religion. He first explains evolution with much fullness of detail and in an entirely nontechnical manner. He corrects at the outset the common error which restricts evolution to Darwinism, although he states that in this book he will deal especially with evolution in the organic kingdoms. He finds some rudiments of the theory in the speculations of the Greek philosophers, and traces its history down to the present time; he tells of the fanciful notions concerning fossils and gigantic bones found in the earth, which were held down to a recent period; he gives a sketch of the spontaneous generation controversy; and in two chapters he presents the evidences of evolution and the objections that have been urged against it. Then taking up the alleged conflict, which he everywhere treats as unreal, he ascribes many of the misunderstandings on this matter to misuse of terms, especially the terms "Creation" and "Nature," which he undertakes to define in accordance with Catholic theology. Classifying evolutionists as monists, agnostics, and theists, he discusses in succession their several standpoints as regards religion. In discussing monism he deals only with the utterances of Ernst Haeckel, whom he handles without gloves. He is more moderate with the expcnents of agnosticism, although rating this view as worse than atheism, because the atheist will discuss the existence of God, while the agnostic denies that there are any data for such a discussion. He falls into the common error as to the source from which Huxley obtained the word agnostic, but gives in a footnote a quotation from a writer who evidently knew its real origin. He sees nothing

* Evolution and Dogma. By Rev. J. A. Zahm, C. S. C. Pp. 461, 12mo. Chicago: D. H. McBride & Co.

hostile to religion in theistic evolution, finding its germs even in the writings of St. Augustine and St. Thomas, while he shows that learned doctors of the Church have defined creation in a way which readily admits the operation of the evolutionary process. Taking up spontaneous generation again, he declares that belief in the possibility of this action—provided that force and matter be always regarded as under Divine guidance—is contrary to neither faith nor philosophy. It is allowable also to believe that man's body was derived from an ancestry of the lower animals, though his soul must be held as "in the case of each individual, directly and immediately created by God himself." Prof. Zahm expresses himself everywhere clearly, temperately, and in a readable manner. This is not his first publication on the relations of science and religion, but it is likely to be his last, as he has been called since it appeared to honorable duties at Rome, which probably will not leave him opportunity for further work in this field.

ALTHOUGH giving quite a full and coherent account of his scientific work, the *Life of Romanes** derives its chief value from the insight it gives into the private life and religious experiences of its subject. For a book written by his wife and completed just a year after his death this is entirely natural and commendable, and being thus largely a memorial tribute of affection it does not challenge the ordinary criticism of the reviewer. The first twenty-five years of Mr. Romanes's life are disposed of in eight pages. Then comes an account of his writing the essay which won the Burney Prize of 1873. The record of his life-work in biological investigations begins with researches on the nervous system of the *Medusæ*; and continues with his work on pangenesis, animal intelligence, physiological selection, inheritance of acquired characters, and various excursions on minor matters. The information given on these subjects is contained mainly in the correspondence which Romanes carried on with Charles Darwin, Francis Darwin, Thiselton-Dyer, E. B. Poulton, E. Schaefer, and others, for his wife has endeavored "to let him, especially in matters scientific, speak for himself." In this respect she is somewhat hampered by the fact that he "lived in almost daily intercourse for parts of many years with more than one of his most intimate friends. Hence there are no letters to several people with whom he was in the habit of discussing scientific, philosophic, and theological questions." There are also many letters relating to his personal affairs, his journeys for recreation or pleasure, and his diversions, of which music, writing poetry, and shooting were the chief. There is an evident solicitude on the part of Mrs. Romanes to show that her husband died in the Christian faith. Early in the volume she describes his period of agnosticism as an "eclipse of faith," and toward the end she devotes much space to his correspondence and his expressions of favorable views on religious matters. No attempt has been made to weigh the value of his contributions to science. The volume is illustrated with a frontispiece portrait and views of two houses in which Mr. Romanes resided.

* The Life and Letters of George John Romanes. Written and edited by his Wife. Pp. 360, 8vo. London, New York, and Bombay: Longmans, Green & Co. Price, $4.

GENERAL NOTICES.

THE author's Fungi: their Nature, Influence, and Uses, which appeared in 1875 and passed through several editions, has long been the standard, and probably one of the best and most comprehensive works in our language on the subject. The rapid advance in knowledge of the life history and development of these organisms during the last ten years, and especially the large scheme of classification carried out by Prof. Saccardo, have, however, made it essential that, in order to keep pace with the times, a guide and introduction should be prepared for the use of students, which, without superseding the volume of 1875 as a popular instructor, should treat the subject more after the manner of a text-book, adapted to the illustration of recent discoveries, and an explanation of the methods of classification. The present work * is the result of an effort to supply this want. The first part of the book—organography—relates to the general character and features of the fungi. An attempt is made in the introduction to differentiate them from the other cryptogams, and particularly from the other thallophytes, the algæ and the lichens. Then the mycelium is described, and in the succeeding chapters the carpophore, or the supporter of the fructification; the receptacle, or envelope of the fructification where there is an envelope; the fructification, fertilization, dichocarpism, or the existence of two distinct forms of fructification; saprophytes and parasites, or fungi that grow on dead and those that grow on living organisms; and the constituents of fungi. The second part is devoted to classification, and begins with a chapter on fungi in general, after which the phycomycetes, the higher fungi, the meromycetes, and the mycomycetes, and their subdivisions—naked, spored, puffball, discoid, subterranean, capsular, gaping, conjugating, rust, mold, and slime fungi, and the rest—are described. The third part includes chapters on the Census of Fungi and their geographical distribution, and an appendix on collecting, to all of which are added a glossary and an index, together with bibliographies of each department.

The sixth edition of *M. Schützenberger's* standard work on *Fermentation* * is substantially a new book. It has been brought up abreast of the present condition of the science, which has made so great advances under the impulse given it by the discoveries of Pasteur. Nothing is required to be said of the importance of the theory of fermentations in science, and in its innumerable applications in the industries, agriculture, hygiene, and medicine. Many of the most important economical processes are dependent upon the action of ferments. In other processes the equally important thing is to prevent or stay it. In the first part of the book the author treats of the fermentations brought about by the intervention of an organized or figured ferment—alcoholic, viscous, lactic, ammoniacal, or butyric—and by oxidation; the second part is devoted to fermentations provoked by the soluble products elaborated by living organisms.

A series of *Chemical Experiments* has been prepared by *R. P. Williams*, author of two other chemical books (Ginn, 60 cents). The experiments are adapted for use with any text-book of chemistry, or without a text-book. They are especially designed to show the properties of substances and classes of substances, and more than half of the one hundred and two experiments—or, more properly, sets of experiments—deal with the reactions used in qualitative analysis. By means of a systematic and condensed mode of statement, directions for a great many operations are put into a moderate compass. The qualities that the author has especially aimed to give his manual are thus stated: "In preparing the experiments the author has endeavored, *first*, to select such as are most instructive and best illustrate the subject without being too elaborate;

* Introduction to the Study of Fungi. By M. C. Cooke. Pp. 330, 8vo. London: Adam and Charles Black; New York: Macmillan & Co. Price, $3.50.

* Les Fermentations (Fermentation). Par P. Schützenberger, Membre de l'Institut. Sixth edition. Pp. 315, 8vo. Paris: Félix Alcan.

second, to arrange them in an order calculated to lead up by the most natural and easiest steps to a knowledge of the science; *third*, to make the subject fascinating by giving just enough information and suggestion to interest the experimenter, and to make him work for the knowledge to be gained. Finally, the author has aimed to make the book simple enough for the dull and slow pupil, and, by the introduction of supplementary and original work, elaborate enough for the most acute." In the analytical part the reactions are given first for each metal of a group separately, thus showing why each reagent is added, and the whole group is then treated in the same way. The value of this method will doubtless be generally admitted. All the right-hand pages of the volume are left blank for notes or memoranda; there are lists of apparatus and chemicals required, directions for making solutions, suggestions for work and note-taking, and a plan of the laboratory of the Boston English High School, where the author is instructor in chemistry. There are thirty-nine cuts of apparatus.

The *Practical Inorganic Chemistry*, recently prepared by Dr. *G. S. Turpin*, of Swansea (Macmillan, 60 cents), is a small experimental manual for beginners, which opens with laboratory exercises that might be classed as either physics or chemistry, and after some drill on setting up apparatus proceeds through a series of simple chemical experiments, including three or four in which quantitative results are required, up to systematic qualitative analysis. The exercises run to one hundred and sixteen in number, and there are sixty-one figures of apparatus

The Subliminal Self (a part of our mind or faculty which apparently exists below the ordinary consciousness) is the chief subject considered in Part XXIX of the *Proceedings of the Incorporated Society for Psychical Research*. (Secretaries' offices, 19 Buckingham Street, Adelphi, W. C., London, and 5 Boylston Place, Boston, Mass.; 4*s*.) In preceding parts of the Proceedings, issued in 1891, 1892, and 1893, Mr. F. W. H. Myers has published seven chapters on this subject, and now in Chapters VIII and IX he continues the presentation and discussion of evidence bearing upon it. He states the general characteristic of the occurrences recorded as "to show us fragments of knowledge coming to us in obscure and often symbolical ways, and extending over a wider tract of time than any faculty known to us can be stretched to cover. On the one side there is *retrocognition*, or knowledge of the past, extending back beyond the reach of our ordinary memory; on the other side there is *precognition*, or knowledge of the future, extending onward beyond the scope of our ordinary inference." Instances of retrocognition differ from those usually classed as telepathy mainly in occurring after instead of at the time of the event. Those of precognition have been known before under the name of premonitions or warnings. A brief note in the same part states that a series of experiments tried by a committee with an Italian spiritualist medium had resulted in revealing nothing but systematic trickery. There is also a brief report of the Hypnotic Committee, a list of members, etc.

A bulletin of much practical value, on *Timber*, prepared by *Filibert Roth*, has been issued by the United States Department of Agriculture. It gives the structure and appearance of hard and soft woods, and describes their mechanical properties and the methods employed for testing them. Other characteristics dealt with in less space are weight, moisture, shrinkage in seasoning, chemical properties, durability, and decay. Directions for distinguishing the different kinds of wood are given, and there are an analytical key to the more important woods of North America and an alphabetical descriptive list of the same. The pamphlet is fully illustrated.

The *Manual of Phonography* prepared by *Norman P. Heffley* (American Book Company, $1.25) is designed especially for class use, but may be used for self-instruction. It is based on the ninth edition of Isaac Pitman's Phonography, but embodies many improvements in teaching that have been made in recent years. The book is thus described by the author: "The 'corresponding' and 'reporting' styles have been blended into a natural and orderly method, each principle when introduced being thoroughly explained and its application illustrated by ample practice in reading and writing. . . . The num-

ber of arbitrary word signs has been reduced to a minimum consistent with requirements for all purposes, and the entire system has been rearranged into a series of easy and progressive lessons. . . . It contains a complete exposition of all the principles, word signs, and contractions that are requisite for the most difficult reporting purposes."

In the bulletin on *Farmers' Institutes* in 1894–'95, issued by the Michigan State Agricultural College, there are reported nine institutes—abstracts of the papers read, and brief summaries of the discussions held at each, being given. These reports have a liveliness and meatiness that mark the meetings as occasions of much profit.

Whittaker, in London, and Macmillan, in New York, publish *The Chemist's Compendium*, compiled by *C. J. S. Thompson* (price, $1). It is a handbook of information for druggists, containing the formulas of the British Pharmacopœia given briefly and arranged alphabetically, a posological table, the unofficial formulary of the British Pharmaceutical Conference, some directions for dispensing French and German prescriptions, besides many lists and tables relating to analysis, poisons, photographic chemicals, freezing mixtures, doses for domestic animals, artificial fruit essences, solubilities, etc., etc.

Volume XXXIV of the Annals of the Harvard Observatory is devoted to a *Catalogue of 7,922 Southern Stars*, by *Solon I. Bailey*. These observations were made from the top of Mount Harvard, near Lima, Peru, and are intended to furnish magnitudes for the southern stars on the same scale as that on which the magnitudes of the northern stars are expressed in Volumes XIV and XXIV. Two chapters describing respectively the plan and the reduction of the observations are prefixed, and another, giving a history of the expedition, in which the obstacles encountered are described and information as to the suitability of a number of sites for astronomical work is given. Part IV of Volume XL and Part III of Volume XLI of the Annals are devoted to meteorology. The former is a report on the *Observations made at the Blue Hill Meteorological Observatory in 1894*, under the direction of *A. Lawrence Rotch*. An appendix to the tables gives the results of a series of comparisons of anemometers begun in 1892. The latter of these publications embodies the *Observations of the New England Weather Service*, which has one hundred and ninety-two volunteer observers, with *J. Warren Smith* as director. Accompanying the tabulated observations and based upon them are a description of the weather month by month, a list of severe storms, and a map showing the mean annual isotherms in New England for 1894.

Terrestrial Magnetism is a quarterly journal which has been added to the list of periodical publications of the University of Chicago. It is edited by Dr. *L. A. Bauer* and a corps of associates representing most of the countries of Europe, the United States, China, Java, and Australia, the intention being to give it an international character. All languages that can be printed with Roman characters will be admitted to its pages. The chief contributions to the first number (January, 1896) are: On Electric Currents induced by Rotating Magnets, and their Application to Some Phenomena of Terrestrial Magnetism, by Arthur Schuster, F. R. S.; and Die Vertheilung des erdmagnetischen Potentials in Bezug auf beliebige Durchmesser der Erde, by Dr. Ad. Schmidt. This number contains also a photographic reproduction of Halley's earliest equal variation chart, with a brief history by the editor. (University of Chicago press, $2 a year.)

The Bachelor and the Chafing Dish is the title of a little book for the gourmet, by *Deshler Welch*. The work consists of a number of "informal" receipts for preparations which can be cooked in a chafing dish. There is considerable somewhat amusing and desultory talk interlarded, most of the receipts being given after the description of an appropriate situation, such as a camp in the woods or at a sick friend's bedside. There is appended a glossary of the various terms used in cooking. (F. Tennyson Neeley, Chicago.)

On account of its covering part of the year of the Columbian Exposition, the *Report of the Commissioner of Education for 1892–'93* contains an unusually wide range of interesting matter. The Exposition material includes essays on the educational

exhibit, as a whole, by various American writers; many accounts of American education by foreign visitors; notes on the exhibits of separate States and foreign countries; and a series of papers prepared for the World's Library Congress, which together constitute a treatise on library economy. Among the subjects presented in other parts of the report are American Educational History; the Report of the Committee of Ten on Secondary School Studies, with papers relating thereto; Pecuniary Aid for Students; the Education of the Negro; and Medical Education. The usual statistics are presented. Those of the common schools show an increase of 1·92 per cent in enrollment and 3·45 per cent in average attendance over the preceding year.

Number 1 of Volume III of The Transit, a magazine published by the Engineering Society of the State University of Iowa, is entirely taken up by a monograph on *Portland Cement*, from the pen of *Charles D. Jameson*, Professor of Engineering at the university. A general consideration of the properties of lime and cement is followed by some historical data regarding the early use of cement both here and abroad, a general review of the methods of manufacture and testing, and the chemical processes concerned in the hardening of hydraulic cements. A number of good pictures show the various pieces of apparatus employed in its manufacture, and several structures in which the so-called monolithic, or artificial stone construction, has been used.

The last publication in the New Brunswick school series to reach us is a little *Teachers' Manual of Nature Lessons*, by *John Brittain*. It aims only, the author says, to be a useful index to some of the elementary chapters of the book of Nature, and to indicate briefly the means by which children may be led to read them with pleasure and profit. The text consists of suggestions for talks and simple experiments illustrating some of the more elementary facts of geology, chemistry, physics, and natural history. (J. & A. McMillan, St. John, N. B.)

A historical and descriptive sketch of *The Yellowstone National Park*, by *H. M. Chittendon*, has recently come to hand. It deals first and principally with the history of the upper Yellowstone, from the days of the early explorers to the present time. The descriptive portion of the work contains a fairly comprehensive treatment of the natural features of the park. Some good maps and a number of well-chosen pictures, the latter of which are somewhat marred by poor paper and printing, add value to the book. A few illustrated biographical sketches of the early explorers and a bibliography of the literature pertaining to the region are appended.

Much of the time expended in computations is wasted through the use of an excessive number of places of figures, and through failure to employ logarithm tables. The use of logarithms for work of four or more places, not only effects an important saving of time over direct multiplication or division, but also conduces to greater accuracy. *Computation Rules and Logarithms*, by *S. W. Holman*, consists of a number of simple rules indicating the number of places to be used in a given computation; "an explanation of the use of the notation by powers of ten; certain instructions, more or less novel in form, as to the use of the logarithm and other tables; and a collection of useful tables." The book is well bound and printed. (Macmillan, $1.)

The Molecular Theory of Matter, which has seldom been given more space outside of Germany than a chapter or two in a general work on physics, now has a volume, by *A. D. Risteen*, devoted to it (Ginn, $2). After giving some general considerations, the author divides his subject into the kinetic theory of gases, of liquids, and of solids, molecular magnitudes, and the constitution of molecules. He aims only to present the accepted views on these topics in a form that can be readily grasped by students, and where competent physicists disagree he lets the fact be known. There are frequent references to original sources, and some fifty diagrams and other figures are used.

The Eclectic School Readings is a series of books to supplement the usual school reading books. Two have come to us, *Stories of Great Americans for Little Americans*, designed for the usual second-reader grade, and *Stories of American Life and Adventure*, for the third-reader grade (American

Book Company, 40 cents and 50 cents). Both are by *Edward Eggleston*, who has aimed to lighten the labor of learning to read by presenting stories containing enough spirit and movement to interest the young. He has also seized the opportunity to implant a love of America in the American child by drawing his subjects from what might be called the heroic age of the United States. We are glad to see such a master hand in writing "true stories" enlisted in the service of the young. The only improvement we could suggest would be to combine a love of Nature with a love of country. A combination of Eggleston and Burroughs, for example, would yield a product well-nigh perfect.

The *Eighth Biennial Report of the Bureau of Labor Statistics of Illinois* is devoted to taxation, and it shows how large property owners, especially in the chief city of the State, throw an unfair portion of the burden of taxation upon their poorer neighbors. This is accomplished by undervaluations often grotesquely small, and by assessing vacant land lower than land of equal value bearing improvements. While Chicago real estate receives most attention, considerable information concerning the property of railroad and other corporations in the State is presented. The Bureau recommends that State taxes be levied solely on site values of land, and advocates several changes in administration. An appendix contains information concerning the coal-miners' strike in 1894, and the decision of the State Supreme Court on the Sweat-shop Act. A compilation of the Labor Laws of the State of Illinois is included in the same volume.

In *Statesman and Demagog*, a pamphlet by *Alphonse Allman*, of San Francisco, a dynamical theory of money is presented, with many mechanical analogies and diagrams. Unfortunately, his analogies seem to run away with him in places, and in making his theory plain to those versed in mechanical principles he has obscured it from every one else.

In *Bilder aus der deutschen Litteratur* the student is given a bird's-eye view of the field, with many favorite ballads, some extracts from longer pieces, and the outlines of the chief prose works, but without too many dates and statistics. The author, Prof. *I. Keller*, of the Normal College, New York, has aimed to use language which the student can read at sight (American Book Company, 75 cents).

The Secret of Mankind (Putnams, $2) belongs to a class of books to which the name Utopian might be given, as it presents the (anonymous) author's ideal of human society in the form of a description of an imaginary state. Another favorite form of writing with a certain class of writers—conversations with the shades of the departed great—is also used. Metaphysics, ethics, government, and education are the chief topics discussed.

Under the title *Light on Current Topics* (Massachusetts New Church Union, Boston, $1) a series of lectures setting forth the teaching of the Swedenborgian Church on certain topics of present interest has been issued in book form. Among the subjects treated by various lecturers are, Theosophy and Religion, The Relation of the Church to the State and to Secular Affairs, and Pauperism and Crime.

The Interstate Commerce Commission has issued its seventh annual volume of *Statistics of Railways in the United States*, giving information about mileage, capital, earnings and other income, expenditures, and charges against income on account of capital covering the year ending with June, 1894. The year was exceptional in several ways. It included the last four months of the Columbian Exposition, which had an important influence on the passenger traffic, and it covered a part of the period of the recent business depression. The latter fact is apparent in all the tables, and especially in the unequaled percentage of the mileage of the country in the hands of receivers.

In its *Report on Coal in Illinois* for 1894, the Board of Commissioners of Labor of that State has presented statistics on the output of mines, value of the coal, cost of mining, number of employees, days of active operation, wages, the use of powder, casualties, and the ventilation of mines. This information is arranged both according to districts as reported by the several State inspectors of mines and in summary form. An appendix contains statistics of the coal-miners' strike of 1894 and of the world's production of

coal, the latter reprinted from a report by Robert Giffen to the British House of Commons.

The *Report of the United States Commission to the Columbian Historical Exposition at Madrid* comprises a brief account of the participation of the United States in the Exposition, by Rear-Admiral Luce, who was the commissioner-general for this country; a report by Dr. Daniel G. Brinton on the collections exhibited; catalogues of the anthropological, numismatic, historical, and other objects sent by various institutions and government departments of the United States; and descriptive essays on several classes of these objects. Mr. William E. Curtis furnishes a report on the historical part of the exhibit, which included seventy-seven portraits of Columbus, only one of which was made during his life, and a considerable number of pictures representing places identified with the life history of Columbus, or the remains of Spanish occupation in the United States, or subjects connected with the origin of the name America. Many of the portraits are reproduced, and other parts of the volume are fully illustrated.

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lies of Synentognathous and their Nomenclature; No. 1052. On the Application of the Name Teuthis to a Genus of Fishes; No. 1053. Notes on the Nomenclature of Scymnus or Scymnorhinus, a Genus of Sharks; No. 1054. Notes on the Genus Cephalentherus or Rafinesque, and other Rays with Aberrant Pectoral Fins (Propterygia and Hieroptera); No. 1055. Notes on the Characinoid Fishes with Ctenoid Scales, with a Description of a New Peectrogaster; No. 1056. The Differential Characters of Characinoid and Erythrinoid Fishes; No. 1057. Notes on Orectolobus or Crossorhinus, a Genus of Sharks; No. 1058. Note on the Fishes of the Genus Characinus; No. 1059. The Nomenclature of Rachicentron or Elacate, a Genus of Acanthopterygian Fishes; No. 1060. Note on the Nomenclature of the Poecilioid Fishes; No. 1061. The Nomenclature of the Fishes of the Characinoid Genus Tetragonopterus; No. 1066. Notes on Asbestos and Asbestiform Minerals; No. 1067. Preliminary Description of Some New Birds from the Galapagos Archipelago; No. 1068. The Classification and Geographical Distribution of the Pearly Fresh-water Mussels; No. 1072. Description of Four New Triassic Unios from the Staked Plains of Texas; No. 1074. Description of a New Subspecies of the Genus Peucedramus Coues.—Union College: Announcement of Courses in the Summer School to be held at Saratoga Springs, July 6 to August 14, 1896.—United States Bureau of Education: Chapters from the Report of the Commissioner of Education; Agricultural and Mechanical Colleges; Forestry Education; Geology in the Colleges and Universities of the United States; Rules for the Spelling and Pronunciation of Chemical Terms.—Van Sargen, Gilbert, and White, T. G.: An Account of the Summer's Work in Geology on Lake Champlain (from Transactions of the New York Academy of Sciences, October 28, 1895).—Walker, S. T.: The Modicum of Hearing of Deaf-Mutes (from the Medical Fortnightly, St. Louis).—Ward, Lester F.: The Data of Sociology (from American Journal of Sociology, vol. I, No. 6).—White, T. G.: The Faunas of the Upper Osdovician Strata at Trenton Falls, Oneida County, N. Y. (from Transactions of the New York Academy of Sciences, vol. xv, pp. 71 to 96).

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Fragments of Science.

Mysterious Fractures in Steel.—The so-called mysterious fractures in steel, with which every engineer is familiar, bid fair to become things of the past. The following facts, taken from a recently reported analysis of specimens from a fractured steamship "tail shaft," are especially interesting, as showing the great value of investigations which at first sight may seem entirely barren of anything but theoretical interest. This accident, which a few years ago would have been put down as one of those "mysterious breaks," probably due to "fatigue," the shaft having been in practically continuous use for twelve or fourteen years, was fully explained by the subsequent examination. A

chemical analysis was first made which indicated that the ingot from which the shaft had been forged was cast too hot; that the carbon was very unevenly distributed, the center of the shaft containing fifty per cent more than the portion near the circumference; and, finally, that the content of sulphur and phosphorus was three times greater in the core than at the circumference, and excessive in all parts of the mass. But the most important and instructive results were obtained in the microscopic examination of sections. Micrometallography is a comparatively new science, which, however, already promises to be of great practical value to the metal-worker. The microscopical examination showed a bad structural arrangement of the iron and steel "cells," especially in the core. The phosphorus, as phosphide, was distributed pretty generally, and the cohesion between crystals rich in phosphide is very faulty. The center of the shaft was riddled with sulphide of iron, and was little tougher than good gray pig iron. "It is almost certain that a number of sulphide flaws of the interior gradually worked outward, along the crystalline junctions of the fairly tough metal outside, until under a vibratory shock of unusual force the whole mass ruptured."

The Tsetse Fly.—The few travelers whose lot has led them through the lowlands of equatorial Africa have most of them reported the tsetse fly (*Glossina sp.*) as one of the most formidable impediments in the way of colonization or even exploration of these regions. Wild animals and human beings suffer only temporary irritation from its attacks, but domestic animals entering the fly districts are seized in the course of a few days with fever and wasting, and almost invariably die. The tsetse is a dipter, having a pale yellow abdomen and gray, striped thorax. It is rather larger than the house fly. The mouth parts form a powerful piercing beak. From an account of a report on the tsetse-fly disease, by Surgeon-Major David Bruce, published in Nature, we learn that there has at last been an attempt made to study the fly and its disease in a thorough and scientific manner. As far back as 1870 a Mr. St. Vincent Erskine endeavored to show that the disease was due solely to change of grass and climate. Since then several other travelers have stated their belief that the fly was not injurious, or, at any rate, that the ill effects of its bite were much exaggerated. At last the Natal Government has authorized Mr. Bruce to thoroughly investigate the tsetse-fly disease, and his paper is the outcome of the first three months' work. The results so far attained seem to indicate not the action of a specific virus, as was originally supposed, but the transmission by the tsetse fly of a bacterium or its products. The investigation is proceeding along somewhat the same lines which Dr. P. Manson is following in endeavoring to trace the malaria plasmodium through the mosquito. A similar relationship was traced some years ago between Texas fever, a disease of cattle, in which certain parasitic bodies were found in the red blood corpuscles, and the cattle ticks (*Ixodidæ*). Among the new facts brought to light by Dr. Bruce's work, one of considerable importance is the specific action which arsenic seems to have on the disease; its administration causes a reduction in temperature, a maintenance of the normal number of red blood cells, and a disappearance of the hæmatozoa from the blood.

Serum Therapy and Blood Brotherhood.—The very ancient practice of the transfusion of blood from one person to another, as a means of cementing friendship, seems, in the light of the modern serum treatment of disease, to have been something more than a purely sentimental operation. In a recent letter to Nature, T. L. Patterson discusses the probable value of such inoculations. He thinks it very probable that a European inoculated with the blood or serum of a native would be better able to resist the climatic changes to which he is subjected in tropical countries. "In other words, would blood inoculation not set up in his system those changes necessary to adapt him to the climate, and render him immune to the diseases which are the result of the climate? The suggestion is based on the assumption that the native is more healthy in his own climate than any foreigner can be, and that blood inoculation would acclimatize the latter at once. The advantages to be derived from such a system are obvious. At present, in central Africa, many missionaries and pioneers are annually sacrificed to the cli-

mate." Blood brotherhood is still extensively practiced among savages, and is common in central Africa; the essential part of the process consists of making an incision just sufficient to draw blood in the right wrist of each of the participants. A little of the blood is scraped off of each cut and smeared on the other's cut. It seems quite probable that a further study of this practice may reveal a prophylactic measure of great practical value.

A New Old Skull.—Prof. A. Nehring has recently described a new human skull of low type found near Santos, in Brazil, of which an account is given by A. C. Haddon in Nature. It was found in a breccia, the exact age of which is uncertain, associated with fish vertebræ, a few fragments of other human remains, and a portion of the lower jaw of a toothed whale. The forehead is low and retreating, the glabella and orbital ridges well developed. The frontal ridge is greatly constricted behind the orbital region, as in *Pithecanthropus*. The principal measurements given are: Maximum length, 183 mm.; maximum breadth, 135 mm.; minimum frontal, 88 mm.; maximum frontal, 92 mm.; frontal sagittal arc, 118 mm.; and the parietal arc, 134 mm. The face of this cranium was strongly prognathous, the whole dentition is strong, and all the teeth are perfectly sound. The dimensions of the premolars and the molars come very close to those of Spy No. 1 skull, any difference there may be being in the direction of the dentition of Spy No. 2. While the length and breadth of the new skull agree fairly closely with those of *Pithecanthropus*, the cranial height is considerably greater, and consequently also the cranial capacity.

Animal Intelligence.—Evidence of the almost human abilities of some of the higher apes is no new thing, but a new series of observations are called attention to in a recent Spectator. The account is taken from A. E. Brehm's book, From North Pole to Equator. "The baboons were on flat ground, crossing a valley, when the traveler's dogs, Arab greyhounds, accustomed to fight successfully with hyenas and other beasts of prey, rushed toward the baboons. Only the females took to flight; the males, on the contrary, turned to face the dogs, growled, beat the ground with their hands, opened their mouths wide and showed their glittering teeth, and looked at their adversaries so furiously and maliciously that the hounds, usually bold and battle-hardened, shrank back. By the time the dogs had been encouraged to renew their attack the whole herd had escaped to the rocks except a six-months-old monkey. The little monkey sat on a rock surrounded by the dogs, but was rescued by an old baboon, who stepped down from the cliff near, advanced toward the dogs, kept them in check by gestures and menacing sounds, picked up the baby monkey, and carried it to the cliff, where the dense crowd of monkeys shouting their battle cry were watching his heroism. The march of the baboons is not a mere expedition of the predatory members of the community. The whole nation *trek* together and make war on the cultivated ground in common. No wild animals have developed their powers of combined attack and defense in so creditable a manner as the baboons. Their motives—defense, not defiance—are irreproachable, and their methods deliberate, self-reliant, and effective, and Brehm justly remarks that there is probably no other male animal which runs into danger voluntarily to rescue a young one of its own species."

Individual Communion Cups.—A gratifying indication of the broadening influence which science is so slowly, but none the less surely, perhaps, exerting among the people at large is contained in the following paragraph clipped from a morning paper, Jersey City, N. J., April 5th: "Individual communion cups were used for the first time in the First Presbyterian Church on Emory Street, this morning. There were six hundred communicants present, each having a new cup. The cup used is glass, with a light gold rim, and is not costly. They were passed around on trays that held thirty-six glasses each. After using, the glasses were placed in the hymn-book racks and were collected by the sexton after the service. The Rev. Dr. Charles Herr, the pastor, said he thought the individual cups had come to stay." As we learn more and more of the means by which disease is propagated, it should be the endeavor of all to aid in the

use of this knowledge in devising new methods or modifying old ones for the prevention of communicable disease, and the extension of it from person to person. In many maladies the secretions of the mouth become highly infected, and are a source of the most immediate danger to any one coming in contact with them. Dr. E. A. Wallace, in writing on this subject, says: "At a recent meeting of the Monroe County Medical Society, in New York, an epidemic of diphtheria was reported by one of the health officers. This epidemic was confined to a single school district, twenty-four families being afflicted. The contagion was traced back to the drinking cup used in school by the diphtheritic children. Microscopic examination revealed the diphtheritic microbes adhering in great quantities to its rim." Dr. Alfred Ashmead says: "The last time I knelt at the communion altar there knelt at one side of me a patient whom I knew (as I was treating him at the time) to be suffering from an odious disease; his mouth contained patches which made it especially contagious. This person took the cup before it came to me; of course I let it pass." (But what of the communicants beyond the doctor who did not know!) In fact, there can be no reasonable doubt that many cases of infectious disease have been and are still caused by the communion cup, and when one considers what some of them are, how horrible the contraction of such a disease is by any one, and how especially pitiful in the case of a young girl, it is hard to be patient with the stupid superstition which upholds the continuance of such a custom. There are so many paths by which infection may reach us, and over which we have, as yet, no control, that the few cases in which we have some power should be made the most of.

Short Method for Producing Antitoxine.—An interesting paper, by Dr. G. E. Cartwright, was recently read before the Royal Society on A Method for Rapidly Producing Diphtheria Antitoxines. Two species of diphtheria toxine were made use of—the ordinary toxine produced by the organism in peptone broth, and secondly the substances present in serum-broth cultivations which had been filtered and heated up to 65° C. As a rule, the broth was inoculated with a virulent diphtheria culture some three or four days previous to the addition of the serum, and then incubated at a temperature of 37° C. for at least three or four weeks. Before being used for injection it was subjected to a temperature of 65° C. for about an hour, and then filtered through a sterilized Chamberland candle to remove the bodies of the bacilli. This fluid the author calls "serum" toxine, in contradistinction to the ordinary poison, "broth" toxine. The serum toxine gives rise to little local irritation, but to marked febrile reaction. In addition it was found that animals which had been subjected to its action were rendered more or less refractory to subsequent infection, and this suggested the possibility of its application as a means of shortening the preliminary treatment which a horse must undergo before it can receive the large doses of broth toxine which are usually necessary for the production of antitoxine of any strength. A horse was treated as follows: He received during the first twelve days three hundred and eighty cubic centimetres of serum toxine spread over three injections on different dates. On the nineteenth day fifty cubic centimetres of unfiltered serum toxine (sterilized at 65° C.) and one hundred and fifty cubic centimetres of broth toxine (of which half a cubic centimetre killed a five-hundred-gramme guinea-pig in forty-eight hours) were injected. The experiment was somewhat impeded at this point by the formation of a small abscess, which was subsequently avoided by filtering out the bodies of the bacilli. On the twenty-eighth day fifty cubic centimetres of the same broth toxine were injected, and on the thirtieth day another injection of one hundred and fifteen cubic centimetres was given. The horse was bled on the thirty-second day of treatment, and the serum was found to possess the strength of ten normal units (one one-hundredth cubic centimetre protected a two-hundred-and-fifty-gramme guinea-pig against ten lethal doses of broth toxine). "As this strength is only attained by Roux's method after at least ten weeks' treatment, it was evident that the serum treatment had considerably shortened the process." The horse was then subjected to the ordinary method for producing antitoxine, when it reacted in every respect like an animal which had been under the usual treat-

ment for several months. In the next horse much larger quantities of the serum toxine were used, with the addition of a certain amount of antitoxine, to avoid the risk of constitutionally injuring the animal. The horse was bled on the thirtieth day, and the antitoxic value of its serum tested. It was found that one one-thousandth cubic centimetre protected completely against ten lethal doses of the toxine; and finally, after nine weeks' treatment, one twenty-five hundredth cubic centimetre protected against ten lethal doses.

Japanese Rice.—Rice is the most important of all Japanese crops; the cultivation takes up more than half of the total surface of arable land. The report of the Chevalier de Warpenarst, Belgian vice-consul at Yokohama, is authority for the following details, which we find in the Journal of the Society of Arts. Japan produces two kinds of rice, viz., rice of the lowlands, which is watered by an ingenious system of irrigation, and the rice of the mountains. The latter requires very little water and sun, while it is impossible to have too much for the former. Lowland rice is subdivided into two kinds—ordinary rice and glutinous rice, the latter forming about eight per cent of the annual crop. The ordinary rice is of three varieties—early, medium, and late. The total rice crop of 1892 was 41,379,000 *koku*, which is equivalent to 205,360,000 bushels. About the end of May the winter crop is gathered in, and some time between the end of September and the end of October the summer crop is ready for harvesting. About 34,000,000 *koku* of the annual production are for home consumption. It is the upper and middle classes who eat rice, the poor being seldom able to obtain it, their food consisting of the leavings of the rich—stale fish and fish entrails, which are cooked all together and sold about the streets on stalls. The farmer himself eats barley, corn, millet, and the sweet potato, but rice only on *fête* days. Besides the 34,000,000 *koku* used for food, there are about 500,000 *koku* used for brewing purposes, and 3,000,000 more in the manufacture of the drink known as *saké*.

Science as a Help to Agriculture.—Much was made of the work of the United States Department of Agriculture in the discussion in the British Association of the question, "How shall agriculture best obtain the help of science?" In the course of the discussion Prof. Marshall Ward said that it was of extreme importance that the results of any investigations should be made known at once and accurately to the practical man, and this was work that might very well be undertaken by the Government; but he deprecated any direction or control from a Government department in any matters of original research. There was at present in existence a large mass of information as to agriculture and forestry which had never yet been made available for the practical man. Criticising some of the methods of agricultural teaching as at present carried out, Prof. J. R. Green said that the farmer was apt to regard chemistry as comprising only the chemistry of soils, whereas it was of even greater importance to pay attention to the chemistry of plants, and generally to give the plant organism the same attention from various points of view that was now given as a matter of course to the animal organism. Prof. Perceval, of Wye College, also emphasized the importance of paying attention to the chemistry of the plant and not of the soil only. Lectures on scientific agriculture were successful if the elements only of the science were explained in non-technical language, and the farmers were then taught to make experiments for themselves. Mr. M. J. B. Dunstan thought much of the prejudice against science arose from the mistaken idea that it was meant to replace experience instead of supplementing it.

Marriage Customs of the Shans.—Marriage celebrations among the Shans are rather unpretentious affairs. The ceremony varies from the simple arrangement of taking each other's word for it to feasts lasting several days among wealthy people; but even in these cases the actual ceremony is a minor feature in the proceedings. The usual form among western Shans is for the couple to eat rice together out of the same dish in the presence of their relatives and the village elders. The bridegroom then declares that he marries the lady and will support her. More ceremony is observed among the Lü. The hands of bride and

bridegroom are tied together with a piece of string after they have eaten together, and an old man pronounces them duly married. The Hkōns throw rice balls at each other and the couple during the ceremony. The newly married couple then go to their house, and split betelnuts are distributed among the relatives of the bride, who give money as a return present. Divorce is readily obtainable, but, except among young people of low rank, is comparatively rare. A man can have more than one wife if he can afford it. In case of divorce the property is divided according to the laws of Menu; and the applicant for the divorce, when the desire is not mutual, or the person through whose fault the divorce is applied for, always loses considerably in the division.

Psychology of Puppies.—A publication on the Psychic Development of Young Animals and its Physical Correlation, by Wesley Mills, embodies the results of the study of a litter of thirteen St. Bernard puppies—ultimately reduced to six—from birth to sixty days of age. The facts most striking in the first few days of life were the frequent desire to suck, the perfect ability to reach the teats of the dam just after birth, the misery evident under cold and hunger, and the fact that the greater part of existence is passed in sleep. Nothing is more striking than the efforts the animal makes almost as soon as it is born to place itself in a surrounding of comfort. Sucking is improved by practice, and is subject to modification with the increasing experience of the animal. The effects of stroking, smoothing movements of the hand are very striking. The temperature sense appears to be well marked from the first, and the muscular sense early present and finally well developed. Even on the day of birth the puppies would not creep off from a surface on which they were at rest if it was elevated a short distance from the ground. Taste and smell are very feeble at first, and are gradually developed. The "opening of the eyes" is a very slow process. It began in the St. Bernards on the eleventh day; but it is doubtful if the animal sees at all, in the proper sense of the word, till the lids are completely separated, if even then. The indications concerning hearing are indefinite and obscure; but the puppies were very early stimulated by concussions. No attempts were made to play while the eyes continued closed; but when play began, the observation of its development was very interesting. On the twenty-sixth and thirty-third days the sense of fun or humor seemed to be shown. The puppies were very readily susceptible to fatigue, in view of which the sleep they indulge in so greatly is seen to be very necessary to them. The first evidence of will, as marked in motions other than those described as reflex, was observed on the seventeenth day. The tail was not wagged while the eyes were unopened. Puppies usually cry like a kitten. Gradually this voice is changed to that characteristic of a dog. Before barking in any form, growling in sleep, and then in play, is observed. Prof. Mills finds two great periods of development in the puppy—one before the eyes are opened, and the other afterward. Development is slow in the first period and existence almost vegetative; an intermediate period is marked by considerable advance, though slow as compared with the progress made in the next few days. The period between the seventeenth and forty-fifth days is the one of the greatest importance; and after that a constant improvement from experience goes on till the sixtieth day. These periods, however, are not distinct, but glide into one another.

The Discoverer of Robinson Crusoe.—In a recent address before the Historical Club of the Johns Hopkins Hospital Dr. William Osler related the curious history of Thomas Dover, of Dover's powder fame, whose contribution to therapeutics seems to have constituted the least of his claims upon posterity. Of the facts of Dover's life little was known. Munk states that he was born in Warwickshire about 1660. He was a Bachelor of Medicine of Cambridge. After taking his degree he settled in Bristol, and having made money joined with some merchants in a privateering expedition. Little is known of his life up to this time. He was associated in this undertaking with a group of Bristol merchants. The expedition went in two ships, and Dover was third in command. The days of the buccaneers were almost numbered, but there was in Bristol at this time one of the last

and one of the most famous of the old South Sea captains, William Dampier, a man who knew more of the Spanish Main and of the Pacific than any one living. He was engaged to accompany the expedition as pilot. They started in 1708, and the voyage lasted three years. In February, 1709, while lying off the island of Juan Fernandez, they observed a light on the shore, and several days later, after the abatement of a storm, which prevented their earlier landing, they went on shore, where they found the original of Defoe's Robinson Crusoe. He was clothed in goat skins, and "seemed wilder than the original owners of his apparel." His name was Alexander Selkirk, a Scotchman, who had lived alone on the island for four years and four months. Captain Thomas Dover returned from the South Seas in 1711, a wealthy man; his subsequent career is only imperfectly known. In 1721, however, he was admitted licentiate of the Royal College of Physicians, a qualification which enabled a man at that time to practice in and six miles around Westminster. In 1732 he published a work entitled The Ancient Physician's Legacy to his Country, in which, he says on the title-page "the extraordinary effects of mercury are more particularly considered." On page 18 is given the formula of his famous powder: "Take opium one ounce, saltpetre and tartar vitriolated each four ounces, ipecacuanha one ounce. Put the saltpetre and tartar in a red-hot mortar, stirring them with a spoon until they have done flaming. Then powder them very fine; after that slice in your opium, grind them to a powder, and then mix the other powders with these. Dose, from forty to sixty or seventy grains in a glass of white wine posset, going to bed, covering up warm, and drinking a quart or three pints of the posset. Drink while sweating." He says that some apothecaries have desired their patients to make their wills and settle their affairs before they venture upon so large a dose as sixty or seventy grains. "As monstrous as they may represent this, I can produce undeniable proofs where a patient of mine has taken no less a quantity than a hundred grains and yet has appeared abroad the next day." Dover continued to practice in London, and in the seventh edition of The Ancient Physician's Legacy there is a letter to him from Catherine Hood, in which she speaks of having consulted him in 1737. He is stated by Munk to have died in 1741 or 1742.

Sisal in the Bahamas.—Sisal fiber which is next in importance to hemp in rope-making, derived its commercial name from the port of Sisal, from which it was originally shipped in the Bahamas. In Yucatan the plant is called *henequen*. *Agave sisalana*, which is its botanical name, had its original home in Mexico; it belongs to the same family as the well-known century plant. On account of its value as a fiber-producer it has now been widely distributed in tropical and subtropical countries. It does not require a rich soil, and can get along with surprisingly little water. The plant is best propagated by means of suckers, which it produces abundantly; they are allowed to reach sixteen or twenty inches in height and are then "lifted" and the roots trimmed and some of the lower leaves removed before resetting. Leaves fit for cutting are produced in three or four years. During the first season of yielding, however, only a few of the larger leaves are removed; subsequently ten or fifteen leaves are cut from each plant. The cutting is done from one to three times a year. The leaves are cleaned by a machine which turns out from one half to one ton of fiber a day; the cleaning should be done within a few hours after the leaves are harvested, as the fermentation which soon starts up in the saccharine matters surrounding the fiber very soon discolors and seriously weakens it. When cleaned before fermentation has set in, the fiber is perfectly white; after passing through the machine it is hung out in the sun to dry, and when dry tied up into bales of three hundred and fifty to four hundred pounds each. An acre of land with six hundred and fifty plants will yield from twelve hundred to fifteen hundred pounds of fiber per annum, the price of which has varied from £50 per ton in 1889 to £13 in 1895. In March, 1896, it was quoted at £17. A plantation lasts about fifteen years, if carefully cared for. It is necessary, however, to be continually replacing individuals that have "poled." This is the supreme effort in the life of many plants of the agave tribe, and with it they complete their life history.

The flowering panicle or pole is a huge inflorescence sent up from the heart of the plant. It is fifteen to twenty feet high, and sometimes higher. From the base, which is about four inches in diameter, it gradually tapers upward into a fine, slender rod. The branches carry numerous greenish-yellow flowers, giving the whole a candelabral character. In *Agave sisalana* the flowers are seldom followed by seed pods; exceptionally, one or two may be produced. When the flowers have fallen off, at the ends of the branches in the axils near the flower scar there are produced numerous small bulbels, which eventually develop into plantlets of considerable size. These are locally called "pole plants," and the sisal plant is capable of being abundantly propagated, either by means of the "pole plants" or "root suckers," the latter of which, however, are preferred by the planters.

The Toba Lake.—The most striking feature of the Batak tableland of Sumatra is the great sheet of water known as the Toba Lake, of which, though only as a name, geographers have been cognizant for more than a century. It lies, according to Baron Anatole von Hugel, about twenty-five hundred feet above the sea; and, trending from the southwest to the northeast, has a length of about fifty miles, with an average breadth of sixteen miles. It is oblong in shape, and has a considerably indented coast line. The natives call it by two distinct names; for the central third of its length is so blocked by a large and populous island as to divide it into two basins. The island consists of a compact mountain range of gentle contour, attaining its greatest height at fifty-two hundred feet. Of the narrow channels which separate this island from the mainland, one is navigable at all times, while the other is so shallow as to be fordable on foot when the water is low. The lake has a considerable outflow, which, after a short course, forms a respectable waterfall, and eventually joins the sea. No river, however, flows into the lake; and the insignificant rivulets and brooks that run down its steep shores are the only visible streams that feed its wide waters—a large expanse, indeed, considering that its water-surface area is three times that of the Lake of Constance. The frequent and regular changes in the hue of the lake are a peculiarity worth mentioning. "Of a morning, the surface being then mostly unruffled, it appears of a fine dark blue, which changes to a greenish tint along the shores; by noon it is of a leaden gray; and of an afternoon it is whitened with foam by a fierce wind, which here blows with strange regularity."

The Professional Criminal.—In a recent article in Blackwood's Magazine Mr. Anderson discusses the appropriate treatment by the state of the professional criminal, and the ineffectiveness of the present system. In speaking of the sentencing of a criminal of this class, who had previously spent several terms in the penitentiary, to five years' penal servitude, he says: "But have the interests of the community been adequately safeguarded in this case? It may perhaps be urged that such a sentence will be inadequate in deterring others from committing burglaries. But what others? People talk as though the masses of the population were kept from crime only by its penalties. As a matter of fact, crimes of this kind ('burglaries') are the work of professionals. Here, then, is a class of men who have deliberately outlawed themselves. They have had warning after warning, but on each occasion have returned to their evil courses, and now, having been once again brought to justice, the state shuts them up for a few years, and at the end of that time they are to be let loose on society once more to perpetrate a new series of crimes." To illustrate the absurdity of such a proceeding, Mr. Anderson suggests a comparison: If game preserves were being destroyed by a fox, and carefully arranged traps were set at considerable expense to catch him, it would be considered a trifle short-sighted if, after capturing and caging the fox for a time, he were again set free, and the same process gone through with at varying intervals for the rest of the fox's life; and yet this is substantially the process which is pursued by the state with the professional criminal. Most of his class are as hopeless, so far as individual reform is concerned, as is the fox. The whole trend of modern criminology points toward the conclusion that he is a criminal through nature, and is as much of

an abnormity as a maniac or an idiot. In other words, he has a dangerous disease, and should be treated as a diseased member, and not as a mischievous boy. His side of the question, however, is of the least importance; society's first duty is to itself. Individuals who can not live in accordance with the laws which govern civilized societies should be placed where they can do the community no harm. On the other hand, the nonprofessional criminal—who, through some untoward combination of circumstances, in a given instance becomes an offender against the laws—is in quite a different relation to the social body from the hereditary criminal. The former deserves punishment; the latter, treatment. Here, then, besides possible wide individual differences, we have a well-marked class difference among criminals, and it is quite evident that society must consider this class difference in devising successful corrective or protective legislation.

The Chamacocos.—Since the discovery by Dr. Bohls in lagoons in the Lengua territory, near the Paraguay River, of that rare and curious fish, *Lepidosiren paradoxa*, in large numbers, scientists have taken a special interest in this region. Cavaliere Guido Boggiani, an Italian artist, recently spent three years near these lakes, living with two of the native tribes, the *Chamococos* and the *Caduveas*, where he seems to have collected much material of scientific value. Henry H. Giglioli, in a recent Nature, gives an account of the ethnological data gathered during the expedition. The *Chamacocos*, who are especially known to ethnologists through their singular long-handled stone axes, are nomads; they are tall, well shaped, the skin of a reddish tinge. The men have long, black hair, which is worn tied in a knot behind, in a thick queue, or flowing loose. The women are less handsome, and wear their hair short. No clothing is worn by either sex, except rough sandals of peccary skin when on the tramp. On festive occasions they decorate themselves with a profusion of feather ornaments, necklaces of seeds, and the rattle of the *crotalus*, the latter of which are worn in diadems, armlets, leglets, and united in bunches as ear pendants. They make rude pottery, but do not use the potter's wheel. From Boggiani's description the *Chamacocos* seem to be an inoffensive and happy people, who relieve their exuberant spirits in frequent festivities; they have numerous games, one of which might be described as primitive lawn tennis. Their weapons are clubs, wooden spears, large bows for shooting arrows, and small bows with a double string used for shooting clay bullets. The women make neat bags and reticules of different kinds of netting and also hammocks, for which they use the fiber of the *ybira*. They have some curious superstitions regarding food; thus, deer flesh is only eaten by men, while women can feed on birds and small game. Among the many interesting facts collected by Boggiani is a small vocabulary of the hitherto unknown language of these people.

MINOR PARAGRAPHS.

The Bulgarians, according to the report of the United States consul at Annaberg, love music. They sing a great deal, at home, in entertainments, and in their occupations. The shepherds or the harvest-reapers on opposite heights often sing in alternation, stanza in answer to stanza. The attendants and armed escorts of traveling parties raise their voices in chorus, and soldiers sing on the march. Musical instruments are much in use—the primitive native ones, and the modern inventions which are taking the place of these. The predominant national instrument is the *gajda*, or bagpipe, the melancholy and monotonous tones of which are precious to them. Other instruments are the *kaval*, a very simple wooden shepherd's pipe, producing a shrill note; the *gadulka*, or *cigulka*, an instrument of two strings, emitting melancholy tones; the gypsy fiddle, or *kemené*, a superior instrument; the *bulgarina*, a sweet guitar with four strings, which is played upon by means of a goosequill; and the *drukja*, or *bajalma*, a similar guitar, played with two fingers. All the instruments are manufactured by the *gajdari*, who formerly constituted in the town a special guild.

It seems that Prof. Fraser, of Edinburgh, who was recently announced as the perfecter of an antitoxine of snake poison, was anticipated in this discovery by Dr. Calmette, of the Pasteur Institute in Paris. Prof. E. Ray Lankester, in a letter to Nature, says: "In the *Annales de l'Institut Pasteur*, May, 1894, Dr. Calmette described in full detail his researches on snake poison, and demonstrated that not only can animals be rendered resistant to cobra (and other snake) poison by the injection into them of graduated doses of the poison (so that rabbits were rendered tolerant of sixty times the lethal dose), but that the serum of such immunized rabbits is found to contain a powerful antitoxine, which can be used successfully as an antidote to snake poison.

An address, delivered at a presentation to Sir Henry Ackland of a bust and some fifteen thousand dollars which will be employed in carrying on the work of the Sarah Ackland Home for Nurses, stated that the testimonial had been subscribed for in commemoration of the long and faithful service that Sir Henry Ackland had rendered to the university, city, and county of Oxford, and the part which he had borne in the advance of medical science in England, more particularly in the direction of sanitary reform and preventive medicine, during the forty years of his occupation of the chair in the university of Regius Professor of Medicine.

The west coast of Stromö, Faröe Islands, is described by Dr. Karl Grossmann as giving excellent opportunities for studying "how the erosion by sea and weather takes hold of the gigantic rock walls, which look as if built for eternity. The caves, which are produced at sea level by the washing out of dikes and cracks, have often most fantastic forms. Sometimes they are arched like a Gothic vault, resembling Fingal's Cave or Nuremberg architecture; in other parts we see a flat, horizontal roof, covering mysterious inlets, reminding us of the entrance to the lethal chambers of the Pharaohs. In many of these caves seals used to breed, but the irrational way in which the natives slaughtered them has finally driven them away altogether. As we row farther north, we encounter many a fine example of rocks that have been broken off and slid down as stacks, which are now separated from the main rock barely wide enough to admit our small boat."

NOTES.

The acquisition by States of tracts of forest is urged by the friends of forestry as a measure for the conservation of water powers, the amelioration of climate, the preservation of scenery, and the instruction of the people. Aside from the benefit thus derived, it is urged that these forests may be made to yield a fair return upon their cost and maintenance. To illustrate the force of this view, Mr. J. B. Walker, of Concord, N. H., refers to a proposition to form such a park out of the Presidential Range of the White Mountains. The region is already a pleasure ground accessible in twelve hours or less to ten million people. It could be greatly improved and its attractions vastly added to by proper forest development, or, more properly, restoration.

Darwin's suggestion that the composition of subsoils might be ascertained from the examination of the piles of earth brought up by earthworms from their holes is said to have been utilized in Australia by a miner who was led to digging for a coal vein which he found from seeing traces of coal in the accumulations of land crabs; and by another, who, acting upon a hint given him by the wombats, found tin ore in the mountains.

The hot caves of Monsummano, Italy, long neglected, are beginning to receive attention again as health resorts. They were discovered in 1849 by quarrymen, and were found to be helpful to those of the men who had suffered from rheumatism. They were visited by Garibaldi and Kossuth for relief from troubles under which they were suffering. They are hollowed in a porous rock, and an air saturated with moisture circulates freely in them at a temperature of about 88° F. The patient who enters them clad in light robes, soon perspires very freely, and may continue to do so during his whole sojourn of from half an hour to several hours.

The third International Congress of Psychology will be held at Munich, August 4 to 7, 1896. It will be opened on the morning of August 4th in the great "aula" of the Royal University. All who desire to further the progress of psychology and to foster personal relations among the students of psychology in different nations are invited to take part in the meetings.

In a recent letter to Science, Prof. Ira Remsen describes a curious natural gas reservoir. A party of skaters in the neighborhood of Baltimore were upon a large artificial lake which was covered with remarkably

clear ice. In various places white spots were noticed in the ice. Some one bored a hole through one of these and applied a flame to the opening, when a gas jet appeared and burned for some time. The gas, of course, was marsh gas, which had collected under the ice and formed the apparent air bubbles.

THE observer who travels about much in the various larger cities of the country, says the Kansas City Architect and Builder, can not fail to notice the marked change that has of late taken place in the construction of large buildings. Everywhere one goes he sees the work going on of putting iron and steel where stone and wood formerly held very much of a monopoly. It is believed by architects and engineers generally to be the beginning of the iron and steel era in building, and that it will go on, becoming more and more general in all classes of building work.

THE bad moral effect of a national policy of militarism and an enormous standing army was recently illustrated in the German Reichstag. The question of dueling was brought up by the death of Herr von Schrader, and various methods for stamping out the practice were proposed. It is well known, however, that the emperor approves dueling, and the result of the debate was nil. The imperial chancellor delivered a speech which practically said that public sentiment in favor of dueling was so strong that prohibitive legislation could not be enforced.

THE centenary of the introduction of porcelain into France is to be celebrated by an exposition at Limoges this year. The history of porcelain manufacture will be traced by specimens of work and processes. The exposition is being organized by the Société Gay-Lussac, working in conjunction with representatives of the town of Limoges.

THE name of the New York Microscopical Society should have been included in the list of the co-operating bodies represented in the Scientific Alliance of New York which was published in the April number of the Monthly.

THE deepest hole in the earth has been bored at Parushowitz, near Rybnik, Silesia, to the depth of 2004·34 metres, or 6,514 feet. At that point the drill rod broke off, and the cost of withdrawing the broken end has prevented a resumption of operations. Eighty-three beds of coal were penetrated during the borings, and 384 thermometrical measurements were taken. The latter indicated a very irregular increase of temperature with the depth.

THE third International Congress for Psychology, Prof. Dr. Stumpe, of Berlin, president, will be held in Munich, August 4, 1897. The names of Profs. Stanley Hall, of Worcester; Henrik G. Petersen, of Boston; William S. Wadsworth (2); C. Staniland Wake, of Chicago; Mark Baldwin, of Princeton; and Edward B. Tichener, of Cornell, are entered upon the provisional list of contributors of papers published April 15th. The American members of the International Committee of Organization are Profs. Baldwin, H. Donaldson, G. S. Fullerton, Stanley Hall, William James, Lightner Witmer, and Newbold.

MACMILLAN & Co. announce as in preparation a Dictionary of Philosophy and Psychology, under the editorial supervision of Prof. Baldwin, of Princeton University. It will contain concise definitions, historical matter, and bibliographies on subjects in the whole range of philosophical study (philosophy, metaphysics, psychology, ethics, logic, etc.). Distinguished American and British specialists will contribute original articles to the several departments of the work.

THE first session of the Bahama Biological Station was held during the summer of 1893 at Bimini Islands, Bahamas. For the coming season it has been decided to locate the laboratory at Biscayne Bay, Florida, in the latitude of the Bimini Islands, and just across the Gulf Stream. Here are found the same equable climate, clear water, and subtropical fauna and flora for which the Bahamas are famous. The station will be under the direction of Prof. Charles L. Edwards, of the University of Cincinnati, and, beginning June 22d, will continue six weeks. The course of instruction consists of lectures, dissection and microscopic work in the laboratory, with observation of the organisms in natural environment. The fee of twenty-five dollars includes tuition, use of microscope, reagents, and material for dissection. Provisions are made for collecting and preserving representative forms as laboratory material.

DR. JOHN RUSSELL HIND, superintendent of the Nautical Almanac, who died near the close of 1895, became generally known about the middle of the century by his discoveries of minor planets, which were then few and rare, and by his computations of the orbits of comets and studies in the history of those bodies. He had been a superintendent of the Nautical Almanac since 1853. He received medals for his discoveries, and was elected to many learned societies.

PROF. ADALBERT KRUEGER, of the Observatory of Kiel, and editor of the *Astronomische Nachrichten*, died April 21st, at the age of sixty-four years. He was for many years assistant to Argelander, whose daughter he married at Bonn, then director of the Observatory of Helsingfors, then at Gotha, and lastly at Kiel. As editor of the *Astronomische Nachrichten* and chief of the central office for the telegraphic transmission of astronomical discoveries, Prof. Krueger was brought into relations with the astronomers of the whole world.